JANUARY 1959—SIXTY-FIFTH YEAR

Machinery

*(left) "America's Oldest Lathe," as determined in a recent contest conducted by the American Machine Tool Distributors' Assn. turning cast iron with an ARMSTRONG Turning Tool Holder.

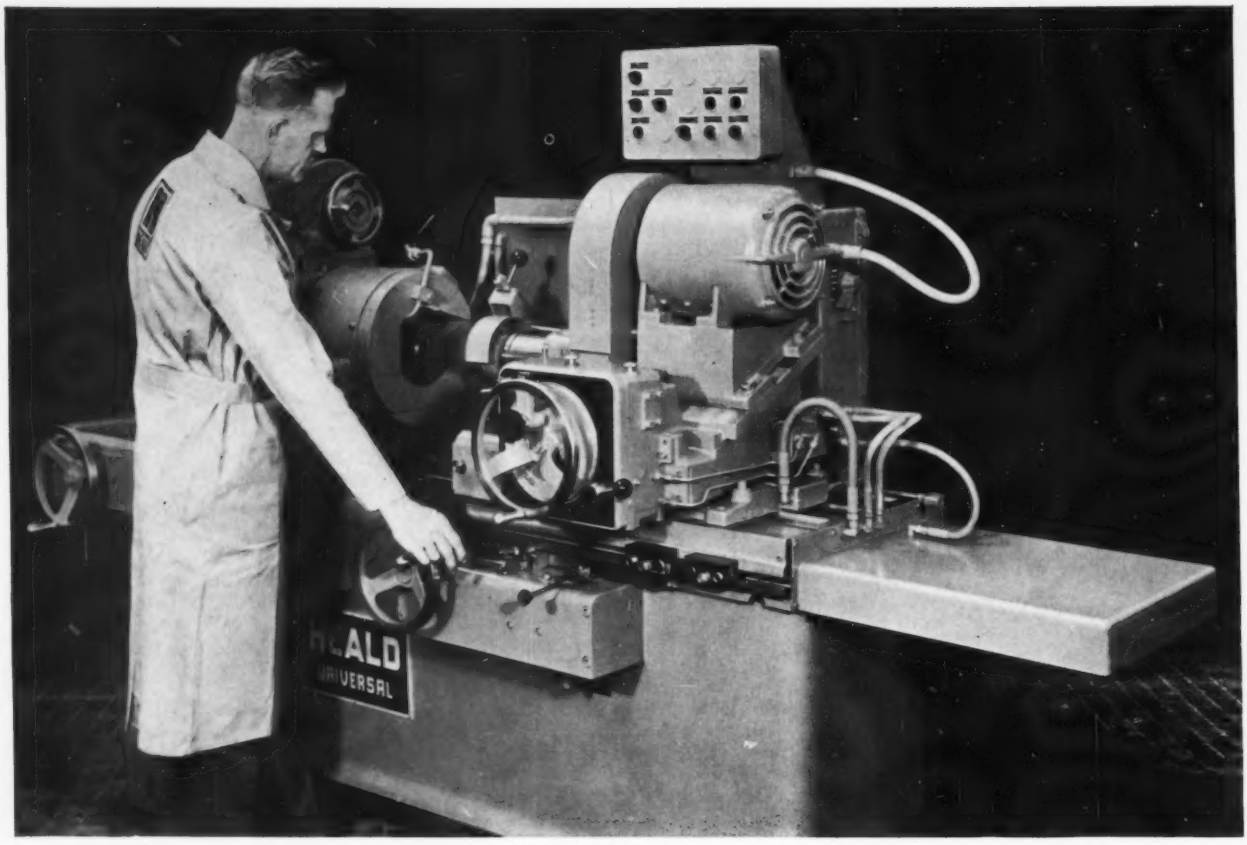
ARMSTRONG TOOL HOLDERS

Whether it's America's Oldest* or America's Newest†

your lathe will operate at its top cutting efficiency when you use ARMSTRONG Tool Holders.

†(right) One of America's most modern lathes, cutting with an ARMSTRONG Carbide Tool Holder.

ARMSTRONG BROS. TOOL CO. *"The Tool Holder People"* **CHICAGO, U.S.A.**



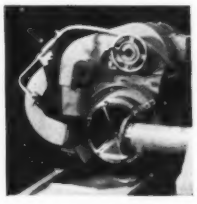
Presenting the Heald Model 273-A

NEW UNIVERSAL

a completely new machine with

1959 PERFORMANCE

and a 1947 PRICE TAG



. . . for I. D., O. D. and Rotary Surface Grinding

THIS is the machine that "couldn't be built" — a better, more *versatile* general purpose grinder that costs about *half* as much as comparable machines today, and *less* than similar machines (with fewer features) cost in 1947!

Here are just a few of its outstanding features:

Hydraulic Anti-Friction Ways — table and cross slide are supported on "pockets" of pressurized oil. A quarter-pound force moves the 1800-pound table.

20-Inch Table Travel — more than in any previous standard base Heald universal grinder.

Workhead Swivels 90 Degrees — permitting rotary surface grinding as well as I.D. and O.D. grinding.

Three Wheelhead Positions — standard, 2″ forward or 7½″ forward for greater grinding versatility.

Vari-speed Workhead Drive — infinitely variable from 150 to 450 rpm.

Swing Inside Standard Guard — 12″.

Standard O.D. Grinding Capacity — 12″.

Accuracy — holds tolerances within .0001″ in routine production and within .000050″ in special cases.

Ask your Heald engineer for the complete UNIVERSAL story. Then compare its performance and cost with *any other machine* available today. And if you have a Heald toolroom grinder that's 10 to 30 years old, you can now replace it profitably — at a cost that's *too low* to pass up.

HEALD®

It PAYS to come to Heald

THE HEALD MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.

Worcester 6, Massachusetts

Chicago • Cleveland • Dayton • Detroit • Indianapolis • New York

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Machinery

JANUARY 1959 **VOL. 65 No. 5**

THE MONTHLY MAGAZINE OF ENGINEERING AND PRODUCTION IN THE MANUFACTURE OF METAL PRODUCTS

SHOP PRACTICE

MACHINE AND TOOL DESIGN

MANAGEMENT PROBLEMS

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DEPARTMENTS

PRODUCT DIRECTORY
206

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255-256

CONCENTRICITY

HELD TO .002"

between workpiece O.D. and thread with ***LANDIS*** *Die Head*

Centering Throat Chasers enabled the LANDMATIC Head to solve a difficult threading problem at the Minneapolis-Honeywell Regulator Co., Valve Division, in Philadelphia, Pa.

Threads on valve stems for diaphram control valves were required to meet a concentricity tolerance of .002" total indicator reading. The 5HH LANDMATIC Hardened and Ground Head using Centering Throat Chasers is the only head tested capable of producing these results.

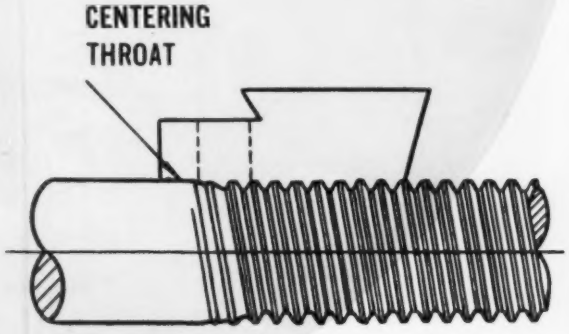
The Centering Throat Chasers used in this operation are specifically designed for producing threads requiring a high degree of concentricity with the outside diameter of the workpiece. Thus they are particularly adapted for cutting long thread lengths where there is a tendency of the workpiece to run out-of-round.

As indicated on the drawing, the centering throat section is allowed to protrude from the chaser cutting edge. This projection varies from $\frac{1}{8}$" for the coarse pitch threads to $\frac{1}{16}$" for the finer pitches. No cutting action takes place on this section of the chaser as it extends over the rotational centerline of the workpiece and only acts as a work aligning and supporting surface.

To produce these stems, $\frac{3}{8}$" 24-pitch UNF threads are cut $1\frac{3}{32}$" long on 316 stainless steel. Cutting at 30 SFM the 5HH LANDMATIC Head mounted on #2 B & S Hand-Operated Screw Machine, produces these threads to *Class 3 tolerances.* Entire lots of 400 pieces are run without regrinding the chasers.

The LANDMATIC Hardened and Ground Head is a stationary head, designed and built to give the great rigidity required for precision threading. It is available in a variety of sizes for producing threads from $\frac{3}{16}$" to 2" in diameter, and uses the LANDIS Tangential Chaser which may be reground and used for 80% of its original length.

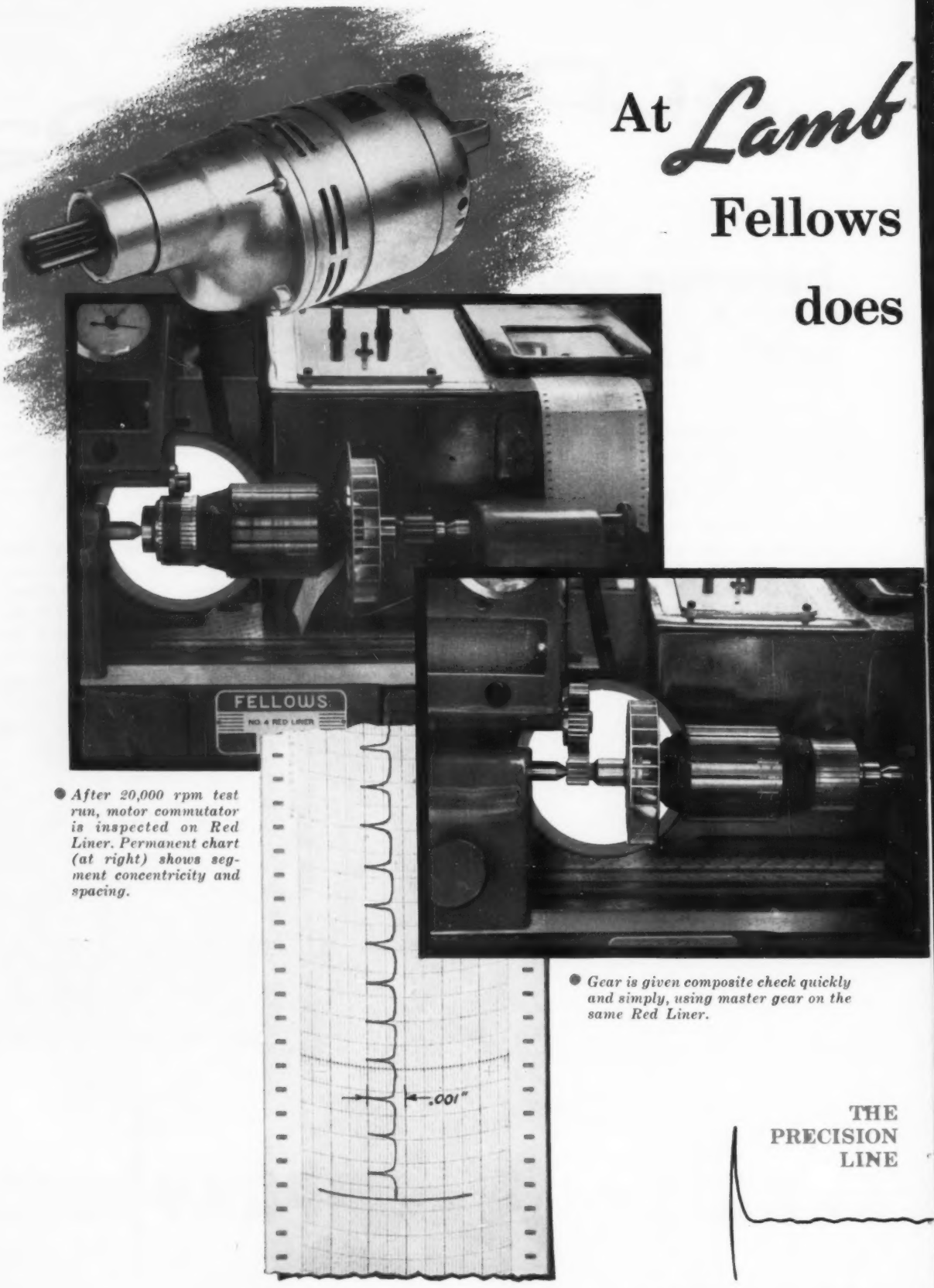
For detailed information, write for Bulletin F-80 — please include specifications.



LANDIS *Machine* **COMPANY** | WAYNESBORO PENNSYLVANIA

473C

At *Lamb* Fellows does



● *After 20,000 rpm test run, motor commutator is inspected on Red Liner. Permanent chart (at right) shows segment concentricity and spacing.*

● *Gear is given composite check quickly and simply, using master gear on the same Red Liner.*

THE PRECISION LINE

Electric

Inspection Instrument

DOUBLE DUTY!

Here's an example of a gear inspection instrument that's also proved ideal for other inspection uses! At the Lamb Electric Company, Kent, Ohio, a standard Fellows No. 4 Fine Pitch Red Liner checks pinions for high speed gear-motors... and inspects the motor commutators too.

When checking commutators for concentricity and spacing of segments, Lamb Electric substitute a ground disk on the master spindle for the master gear ordinarily used. Inspection is fast and accurate. Commutators are checked after baking and after each high speed test. The permanent chart made by the Red Liner permits easy comparison of successive test results.

The low output speed, high torque gear-motors manufactured by Lamb Electric demand precision in every detail. Gears are produced on a Fellows 3" Fine Pitch Gear Shaper and inspected on one of four Fellows inspection instruments, with consistently excellent results in production speed and accuracy.

For full information about the complete Precision Line of Fellows gear production equipment, get in touch with your Fellows representative. Contact any Fellows office.

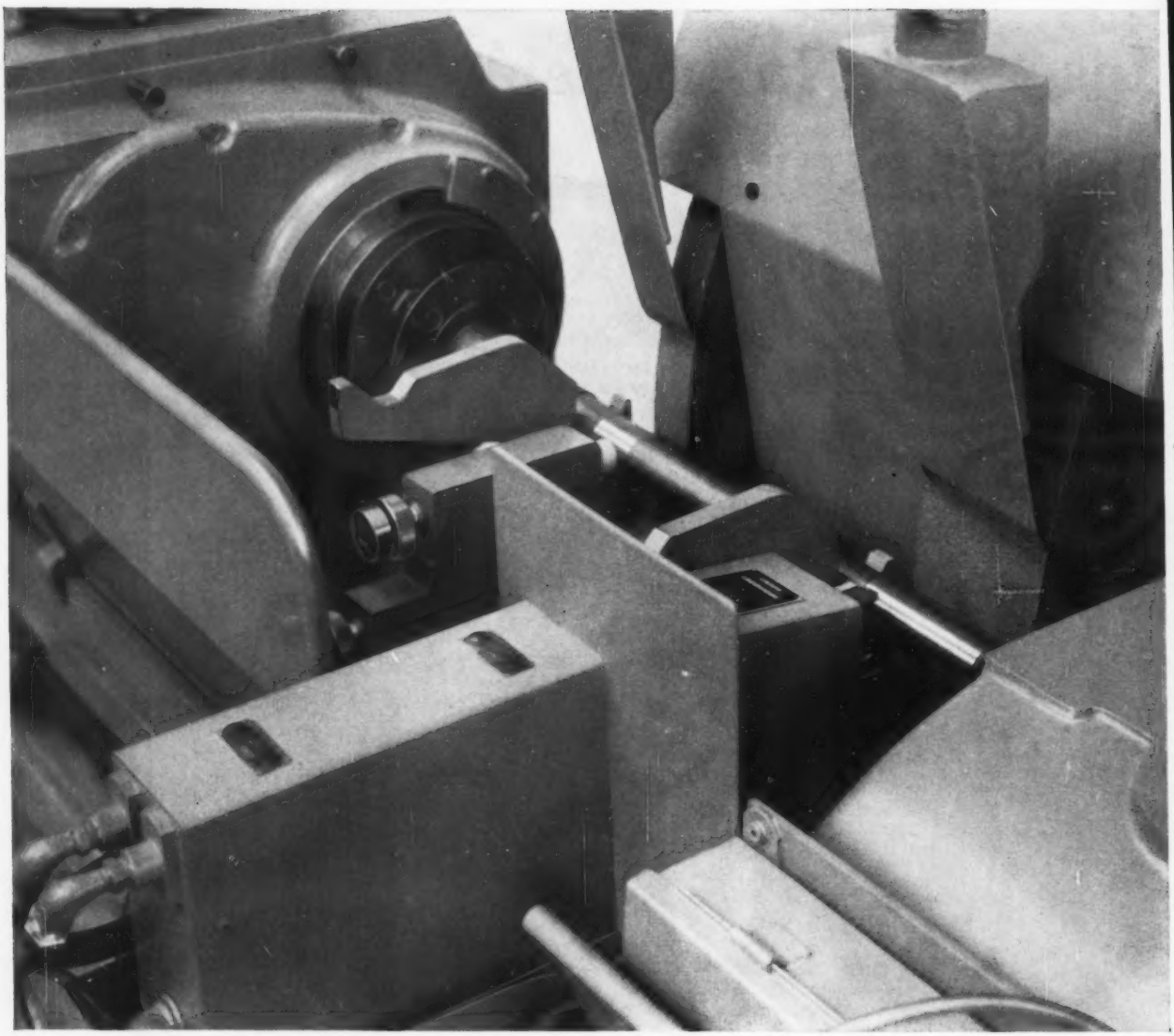
THE FELLOWS GEAR SHAPER COMPANY
78 River Street, Springfield, Vermont
Branch Offices: 1048 North Woodward Ave., Royal Oak, Mich.
150 West Pleasant Ave., Maywood, N. J.
5835 West North Avenue, Chicago 39
6214 West Manchester Ave., Los Angeles 45

Fellows No. 4 Fine-Pitch Red Liner

Fellows *Gear Production Equipment*

For more data, circle this page number on inquiry card

2 widely spaced



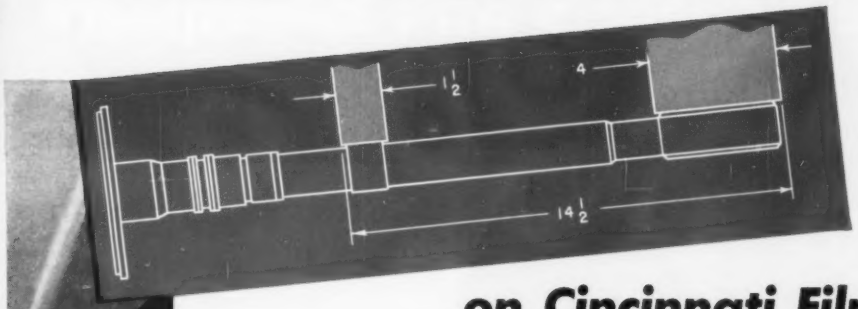
Two different diameters spaced 9" apart are automatically ground and sized with the aid of a jump type automatic air-electric gage sizing unit. The machine is a CINCINNATI FILMATIC 10"R x 36" Plain Hydraulic Grinder.

FILMATIC

CINCINNATI®

CENTERTYPE GRINDING MACHINES • CENTERLESS
MICRO-CENTRIC GRINDING MACHINES • CHUCKING

diameters ground simultaneously



Drawing of part. Part name, output shaft . . . Stock removal .010" . . . Material, steel . . . Estimated production, 104 per hour @ 80% efficiency.

on Cincinnati Filmatic 10" R Plain with JUMP type gage sizing

Most promising way to reduce precision grinding costs . . . combine operations. This approach to cutting cost is especially attractive when the machine is basically standard, like the CINCINNATI FILMATIC 10"R Plain Grinder illustrated here. It precision grinds and automatically sizes two widely spaced diameters at the same time. ¶ Cincinnati Grinding Specialists incorporated several cost-reducing features in this machine, including a new type of horizontally mounted automatic air-electric gage sizing unit. At a predetermined point in the grinding cycle, usually when about .007" grinding stock remains, the "jump" mechanism automatically advances and the contacts engage the work. The gage mechanism automatically retracts after the work is ground to size. Wear and maintenance of the sizing elements are thereby greatly reduced. ¶ Other equipment contributing to the machine's excellent performance record include push-button dual rate automatic infeed; loading cradles with a parking place for the next part; push-button behind-the-wheel profile truing; automatic gap eliminator; hydraulic footstock. Of course, standard FILMATIC grinding wheel spindle bearings are the deciding influence in grinding with spaced wheels spanning 15" up to 9" combined wheel width. ¶ This equipment typifies Cincinnati's advanced thinking in supplying machines completely tooled up to meet today's production and cost requirements. Our Specialists can help you, too. Ask for a visit by one of our field men.

CINCINNATI

CINCINNATI FILMATIC 10"R x 36" Plain Hydraulic Grinder, equipped for push-button operation. Equipment of this type is engineered by Cincinnati Grinding Specialists.

GRINDING MACHINES • ROLL GRINDING MACHINES
GRINDERS • CENTERLESS LAPPING MACHINES

GRINDING MACHINE DIVISION
The Cincinnati Milling Machine Co.
Cincinnati 9, Ohio

For more data, circle this page number on inquiry card

Why Landis grinders with Microsphere

exclusive Microsphere spindle bearing

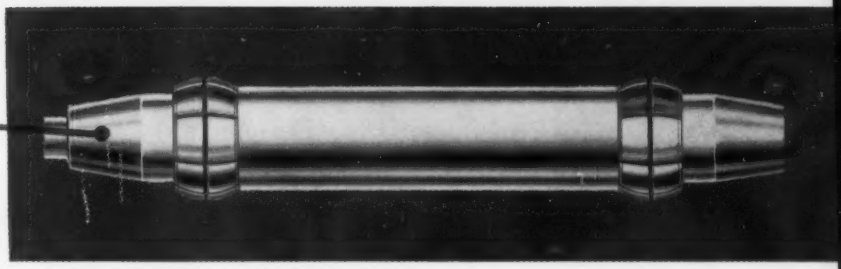
plain grinders	universal grinders	centerless grinders
		
4" to 36" swing *18" to 240" between centers* *3 to 30 hp wheel drive*	*10" to 48" swing* *28" to 120" between centers* *1½ to 7½ hp wheel drive*	*1/16" to 6" work diameter* *15 to 25 hp wheel drive*

LANDIS

precision grinders

bearings give precision *plus* production

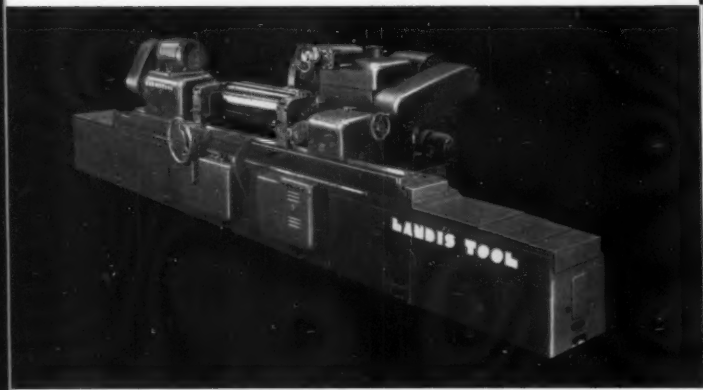
exclusive rigidized wheel spindle



Here's why Microsphere bearings *and* rigidized spindle give precision *plus* production.

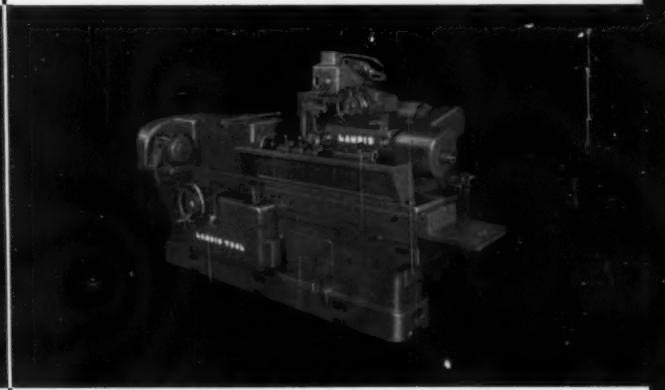
- heavy cuts to close tolerances because of bearing and spindle rigidity
- closest running clearance gives fine finishes and quick positive sparkout
- trouble-free operation with one-piece bearings and simplified construction

roll grinders



10" to 60" swing
48" to 288" between centers
5 to 40 hp wheel drive

special purpose grinders

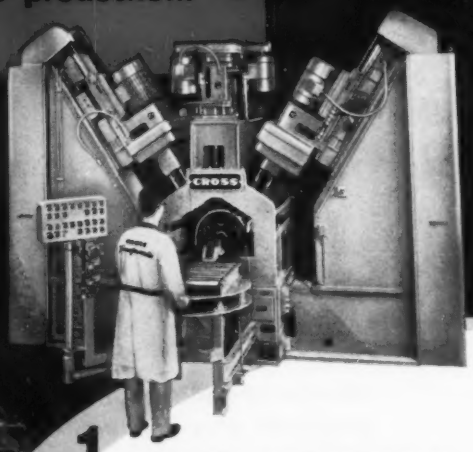


multiple wheel, concentric,
automotive types:
crank, cam, piston, valve

LANDIS TOOL COMPANY / WAYNESBORO, PENNSYLVANIA

6 ways to automate

Cross automation takes many forms . . . from the simplest low production machines to complex equipment for mass production.

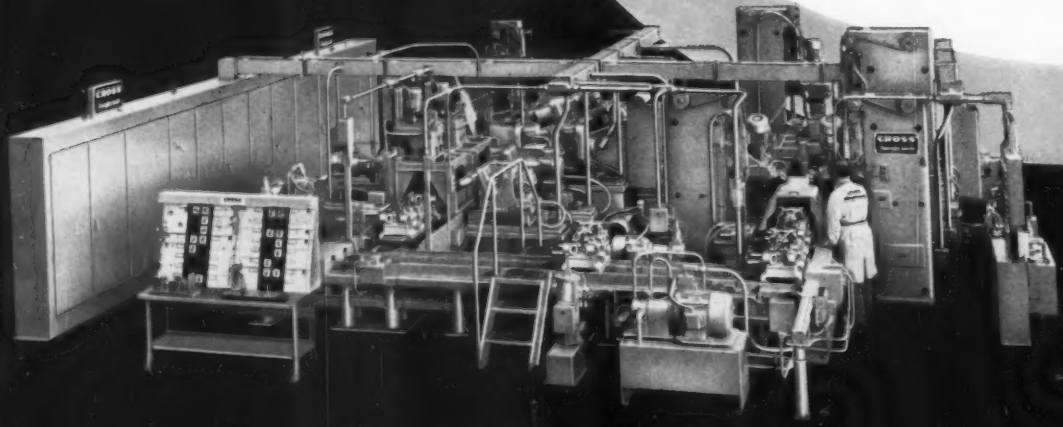


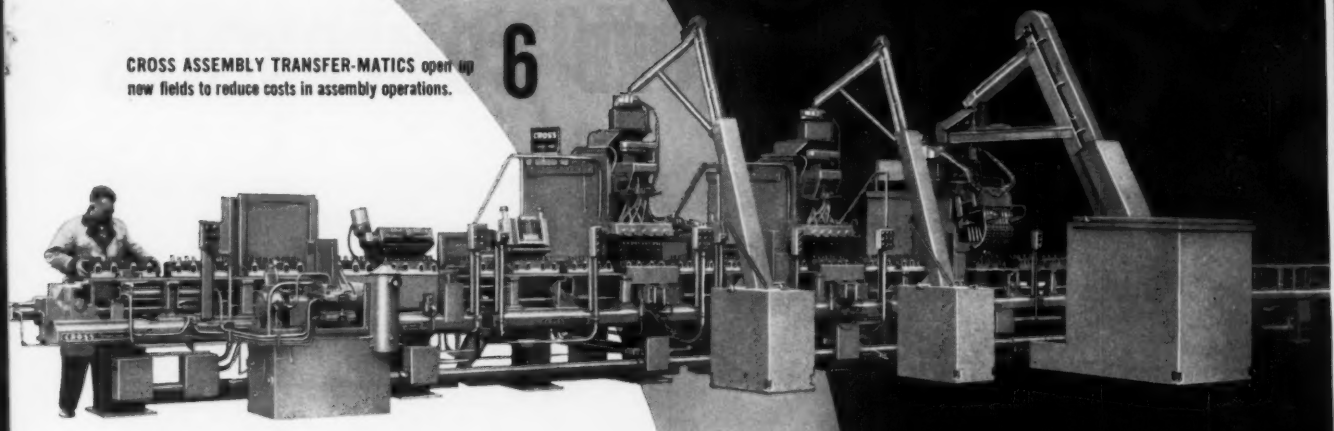
1 **CROSS SINGLE STATION MACHINES** exist in many configurations to combine operations.

2 **CROSS DIAL TYPE MACHINES** provide multiple station performance with minimum floor space.

3 **CROSS TRUNNION TYPE MACHINES** are compact multiple station units that permit operations on opposite sides of the part.

4 **CROSS PALLET TYPE TRANSFER-MATICS** provide capacity for combining a large number of operations. Standard pallet fixtures handle irregularly shaped parts with maximum flexibility.



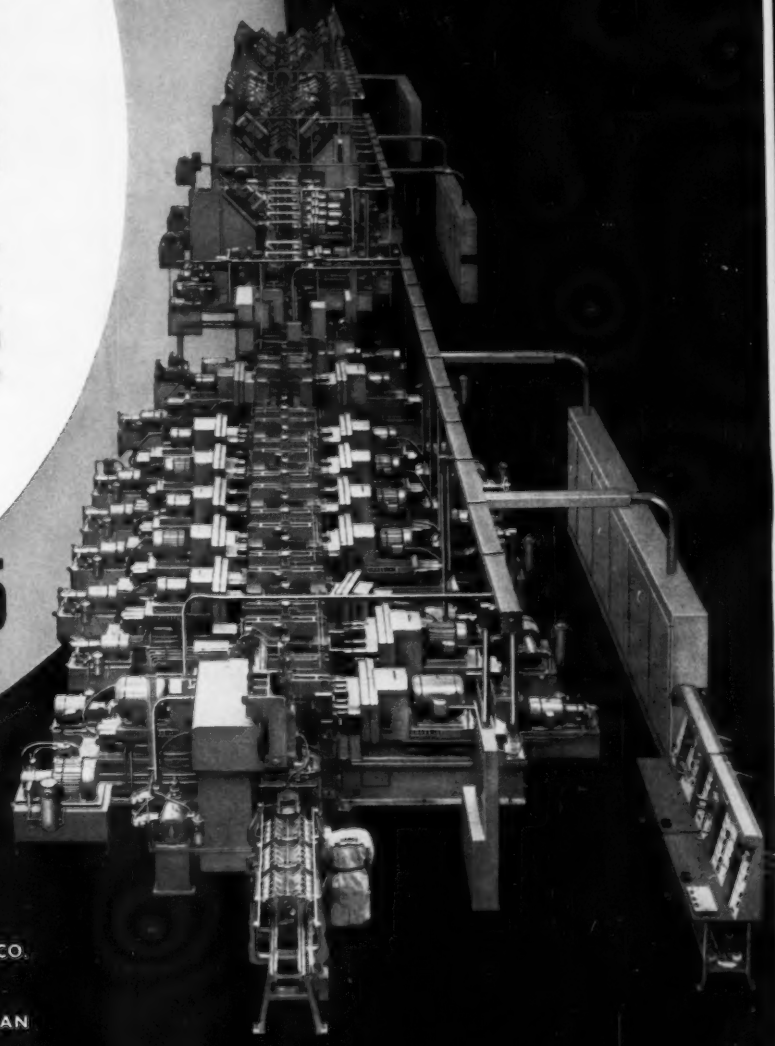


CROSS ASSEMBLY TRANSFER-MATICS open up new fields to reduce costs in assembly operations.

6

The six machine types illustrated here were created by Cross to apply the principles of automation to a wide variety of metalworking operations. Thus, Cross makes available the benefits of automation to small or large manufacturers, regardless of required production volume.

Cross sales engineers are available to discuss your automation problems with you. They will also be glad to discuss the new Cross Process Development Service created to solve *unusual* automation problems—in or out of the metalworking field.



CROSS SECTIONIZED TRANSFER-MATICS provide a means of combining unlimited numbers of operations. Automatic in-process work storage minimizes downtime and increases operating efficiency.

5

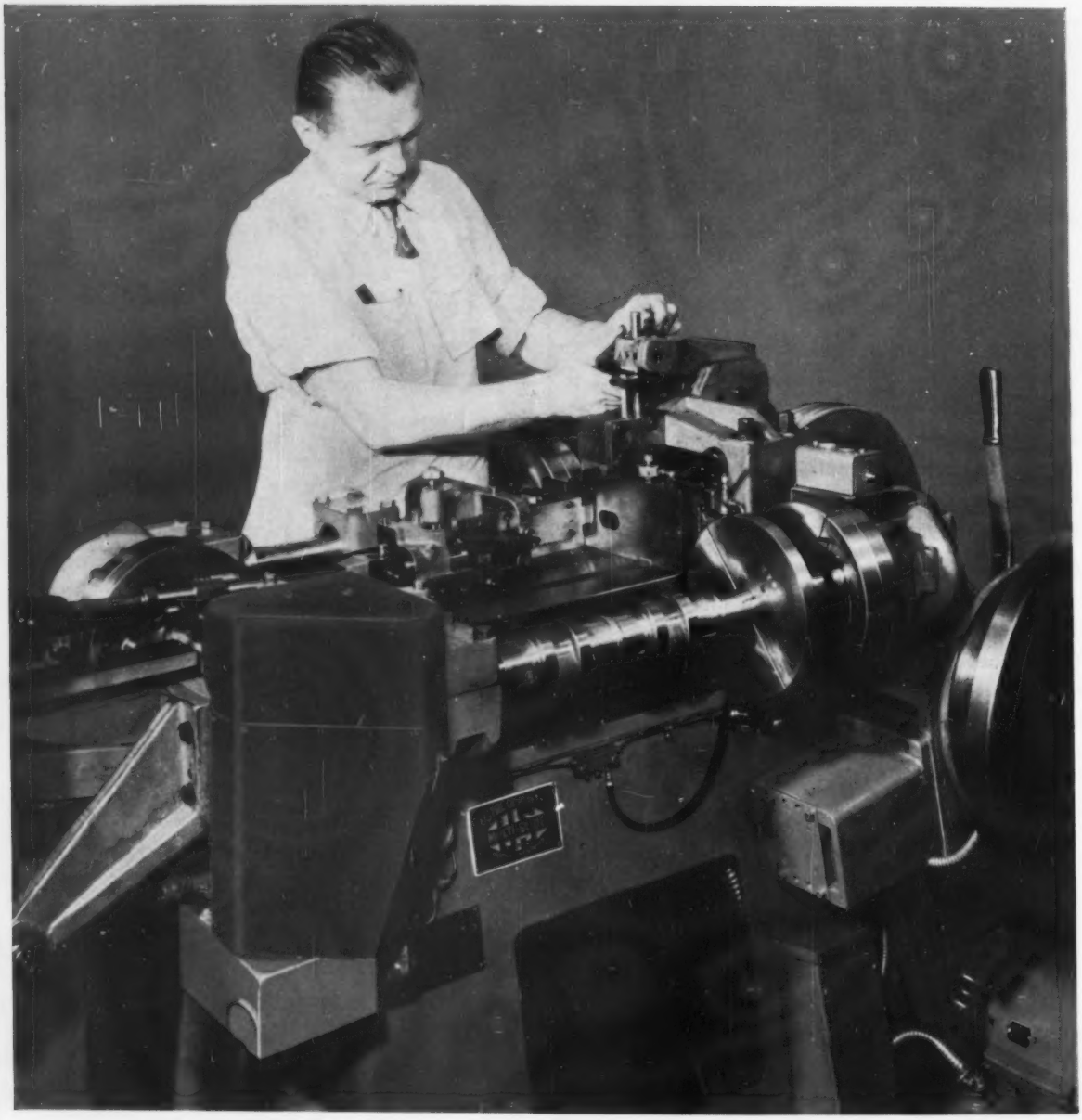
Established 1898

THE **CROSS** CO.

First in Automation

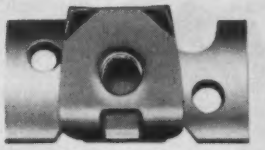
PARK GROVE STATION • DETROIT 5, MICHIGAN

produce your STAMPED COMPONENTS

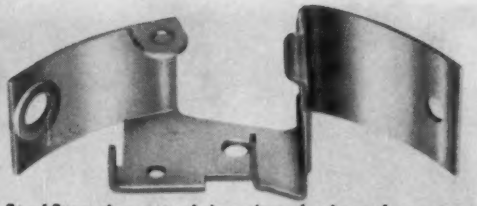


Setting up tools in #28 U. S. Multi-Slide.

WITHOUT SECONDARY OPERATIONS

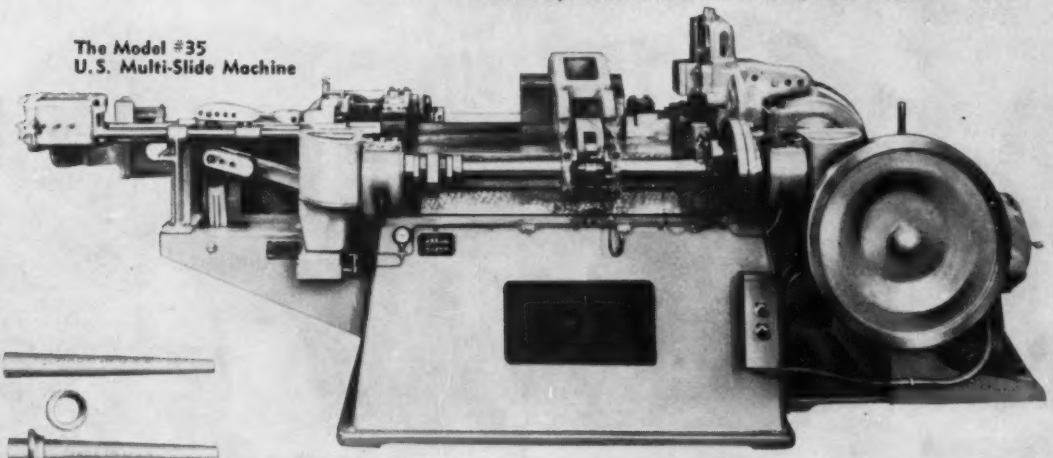


Brass Stamping, twice actual size, pierced, trimmed, formed, counter-sunk and tapped in one operation on U. S. Multi-Slide, Model #33.

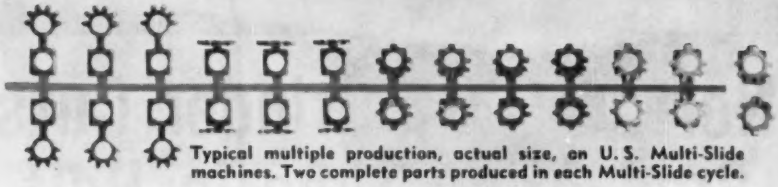


Steel Stamping, actual size, pierced, trimmed, countersunk, beaded and formed on various planes. Produced in one operation on U. S. Multi-Slide, Model #35.

The Model #35
U. S. Multi-Slide Machine



Aluminum conical tube, actual size, and shaped collar assembly. Both pieces produced and assembled simultaneously in a single cycle of U. S. Multi-Slide, Model #28.



Typical multiple production, actual size, on U. S. Multi-Slide machines. Two complete parts produced in each Multi-Slide cycle.

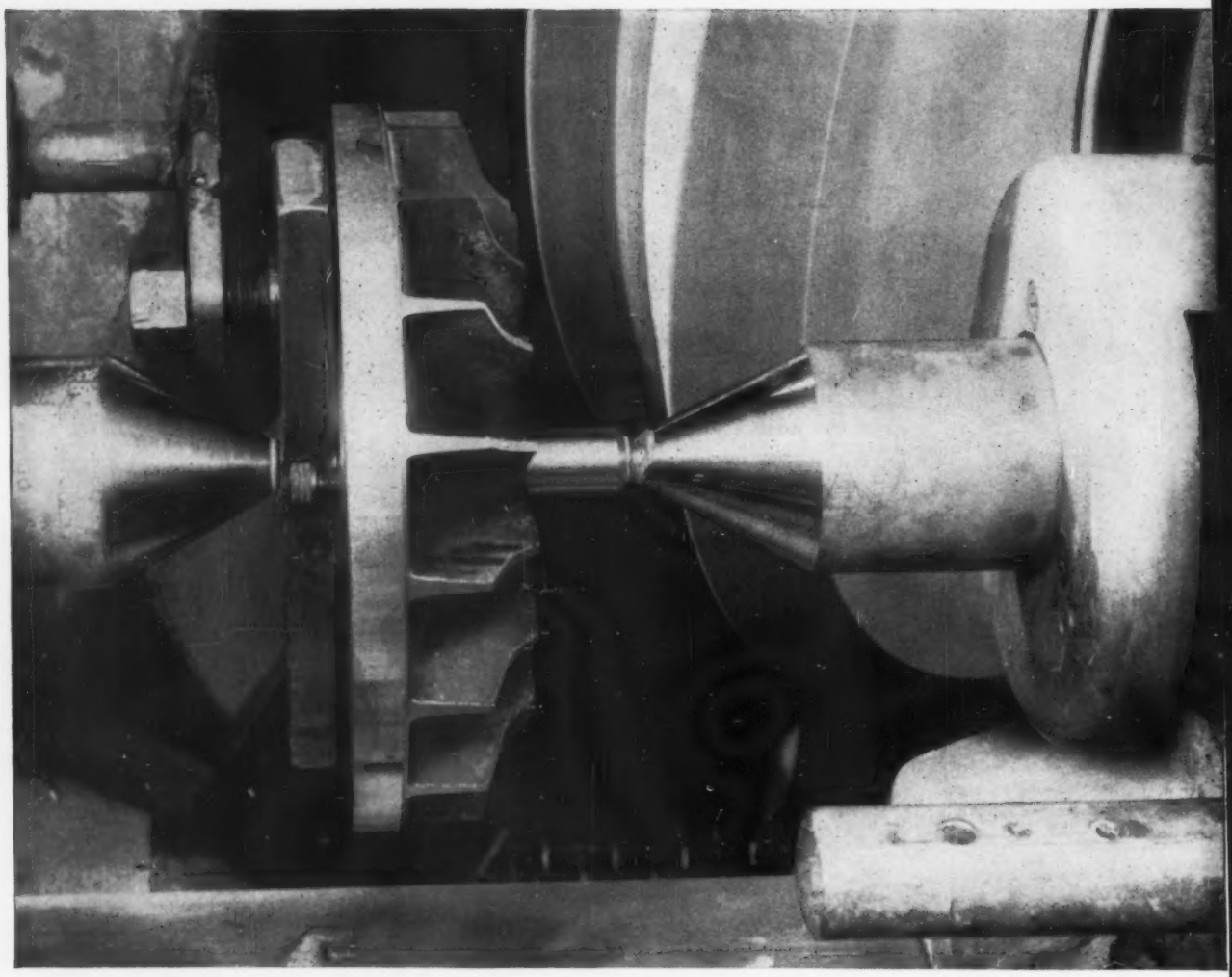
In a single U. S. Multi-Slide® cycle you can pierce — trim — countersink — bead — emboss — swage — tap — form — and assemble in almost any combination ● U. S. Multi-Slide "built-in motions" offer a practically unlimited variety of tooling possibilities. **In One Operation** you can produce components and assemblies that would ordinarily require multiple handling ● Stampings or assemblies produced on the U. S. Multi-Slide are consistently uniform and to required tolerances ● If you produce or purchase stamped components, investigate the cost saving potential of U. S. Multi-Slide machines. ● Ask for a copy of Bulletin 15-M or to compare manufacturing costs—send in samples or drawings of the part you want to produce.

U. S. TOOL COMPANY, INC. AMPERE (East Orange) NEW JERSEY

U. S. Multi-Slides® • U. S. Multi-Millers® • U. S. Automatic Press Room Equipment • U. S. Die Sets and Accessories

MULTI-SLIDE

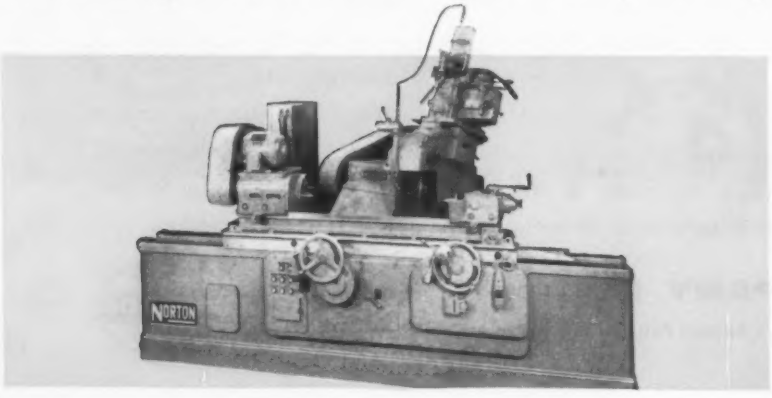
For more data, circle this page number on inquiry card



Norton CV-4 Grinder Cuts Production Time in Half

...at large west coast engine component plant

Saves on Grinding Operations



One Operation Does It! A Norton Type CV-4 10" Semiautomatic Angular Wheelslide Grinder was installed by the AiResearch Industrial Division of the Garrett Corporation to precision grind diesel engine turbocharger turbine wheels to increments as fine as .0005". Previous grinders performed 4 separate grinding operations. The Norton CV-4 increased efficiency and reduced grinding to a single operation. As a result, production time dropped from 19½ to 8½ minutes, for each turbocharger . . . a 56% reduction!

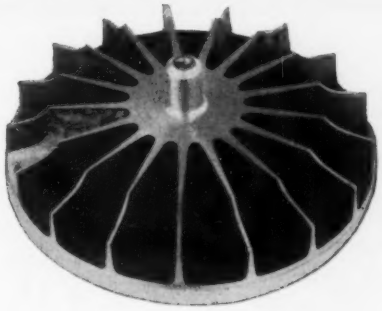
"Norton Type CV-4 Semiautomatic Angular Wheelslide Grinders combine shoulder and diameter grinding to give big operation economy."

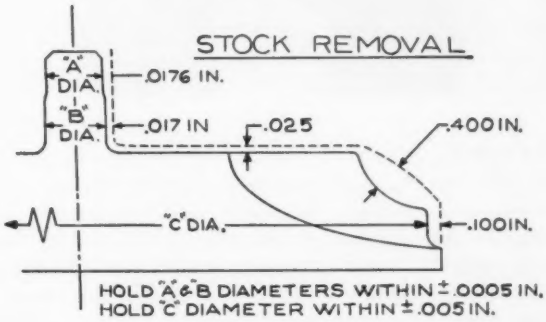
Combining several precision grinding jobs and doing them faster and better is routine performance for this cylindrical grinder. For example, it leaves a concentric grain pattern on shoulders, improving the sealing quality and appearance. The CV-4 gives the "Touch of Gold" to your production by reducing effort, time and costs, and increasing your grinding profits.

- Automatic grinding cycle saves operator's time and effort and makes possible his tending more than one machine. Once the cycle starting lever is pulled the machine takes over and automatically grinds to size.
- Automatic wheel head mounted truing device provides pushbutton control of straight, stepped or formed wheel truing—eliminates need of skill and reduces wheel cost per piece ground.
- Ramped outlet from coolant tank speeds clean-out . . . pumps and motors all outside and easy to reach . . . electrical controls all grouped in raised enclosure . . . base ways protected by steel tape guards, requiring no additional floor space . . . hydraulic oil and ways lubricant carried in outside reservoirs with large gauge-glasses.

Type CV-4's can do the work of two or more ordinary cylindrical grinders in your plant. They are available with hand table or hydraulic power table traverse in 10″ and 14″ sizes, and in work lengths of 18″, 36″, 48″ or 72″. *Improve your competitive position and increase your grinding profits* — replace obsolete grinding equipment with these modern machines. Ask your Norton Representative for Catalog No. 1658-2, or write us direct. Remember, only Norton offers you such long experience in both grinding machines and grinding wheels to bring you the "Touch of Gold" that helps you produce more at lower cost. NORTON COMPANY, Machine Division, Worcester 6, Mass. In Canada: J. H. Ryder Machinery Co. Ltd., Toronto 5.

Set-And-Forget Automatic Operation Saves Labor . . . requires minimum of manual operation . . . loading, locating, starting cycle and unloading. Thus valuable labor is released for other work, yet precision is automatically maintained. For stock removal see diagram below.





To Economize, Modernize with **NEW**

NORTON

GRINDERS and LAPPERS

Making better products . . . to make your products better

NORTON PRODUCTS Abrasives • Grinding Wheels • Grinding Machines • Refractories • Electrochemicals — BEHR-MANNING DIVISION Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

For more data, circle this page number on inquiry card

CIMCOOL ANNOUNCES...

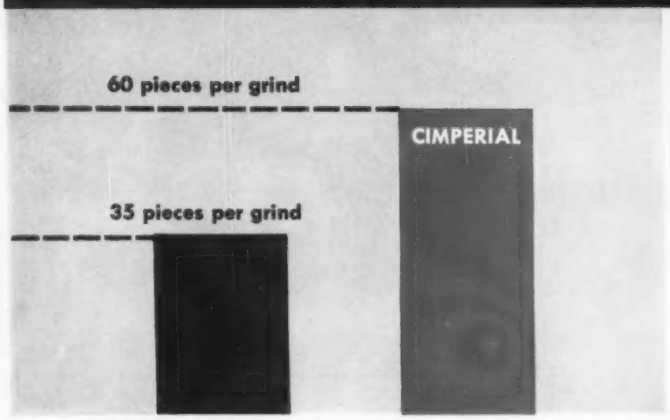
CIMPERIAL

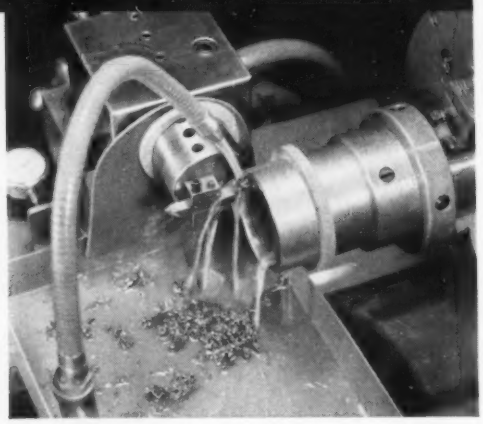
A Crowning Achievement in Cutting Fluids!

Now—Cincinnati Milling Products Division presents the most advanced cutting fluid in the history of the industry—CIMPERIAL, crowning achievement of the great line of CIMCOOL° products!

Since shortly after World War II, the Cincinnati Milling Products Division has conducted continuous and exhaustive research into Cutting Fluid action. This intensive study led to the introduction of radically different CIMCOOL, and then nationally acclaimed CIMCOOL S2. And now—CIMPERIAL!

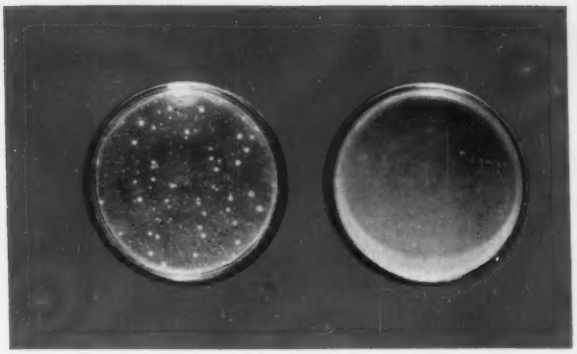
CIMPERIAL IS THE NEW SOLUTION FOR METAL CUTTING PROBLEMS!



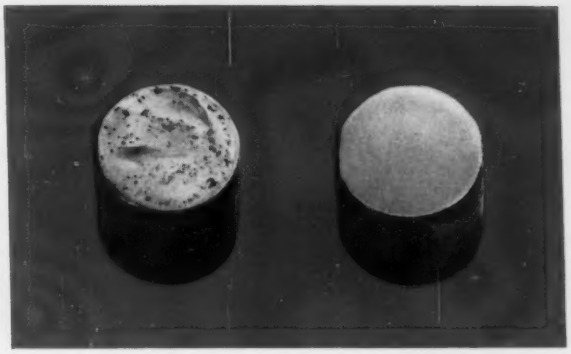


CIMPERIAL, a chemical solution, *defeats heat* and *increases tool life*. CIMPERIAL's new extreme pressure (EP) additives, which it contains in abundance, withstand high temperatures and pressures. By lowering friction, one source of heat is reduced. CIMPERIAL also decreases the larger source of heat, metal deformation. Through the elimination of both sources of heat to a remarkable degree, CIMPERIAL greatly increases effective tool life, and permits *faster speeds and feeds*. For example, in the plant of a diesel engine maker, CIMPERIAL boosted the average pieces per tool grind from 35 to 60 (a 70% increase) on a special lathe turning cast iron pistons complete.

CIMPERIAL, in a series of exhaustive tests, obtained more efficient metal cutting action with less force on the tool than either a soluble oil or a cutting oil. The threading operation pictured here shows the set-up of one of the many tests made. CIMPERIAL obtained a better finish, visible proof of the effectiveness of CIMPERIAL's newly discovered EP additives.

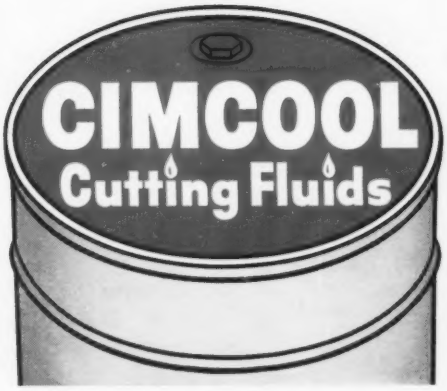


CIMPERIAL has a maximum amount of effective bactericides. It contains no food for bacteria . . . will *not* turn rancid! On the left in the illustration, note the white specks. These are bacterial colonies grown in three days from a measured quantity of ordinary tap water. On the right, the same tap water was used to dilute CIMPERIAL. After three days, no bacterial growth has occurred, due to the effective bactericides in CIMPERIAL.



CIMPERIAL offers positive rust control unequalled by any other water miscible cutting fluid. This rust control is obtained by incorporating two types of chemical rust inhibitors which work independently to counteract corrosion on all metals. Mixtures of CIMPERIAL and a soluble oil, each at 1:40, were left overnight on the polished steel cylinders shown above. CIMPERIAL shows no rust; the soluble oil sample shows light rust overall, with one area of intensive rusting.

YOU, TOO, can lower tool costs and increase your production with new, revolutionary CIMPERIAL! In CIMPERIAL, the Cincinnati Milling Products Division has developed the most advanced and completely effective cutting fluid in the metal-working industry. It is an entirely *new* chemical concentrate *especially designed for heavy-duty applications.* CIMPERIAL is the only water-soluble fluid capable of performing the tough, low-clearance, low speed operations previously limited to cutting oils. CIMPERIAL also provides excellent cutting action on standard operations. CIMPERIAL is a *chemical solution*—not an emulsion—which effectively covers *95% of all metal cutting jobs.*



FOR 100% OF ALL METAL CUTTING JOBS

Production-proved products of The Cincinnati Milling Machine Co.

CIMPERIAL—*newest* in the world-famed, industry-proven line of **CIMCOOL Cutting Fluids! CIMCOOL S2 Concentrate**—Covers 85% of all metal cutting jobs. **CIMPLUS**—The transparent grinding fluid with exceptional rust control. **CIMCUT Concentrates (AA, NC, S5)**—For jobs requiring oil-base cutting fluids. **CIMCOOL Tapping Compound—CIMCOOL Bactericide—CIMCOOL Machine Cleaner.**

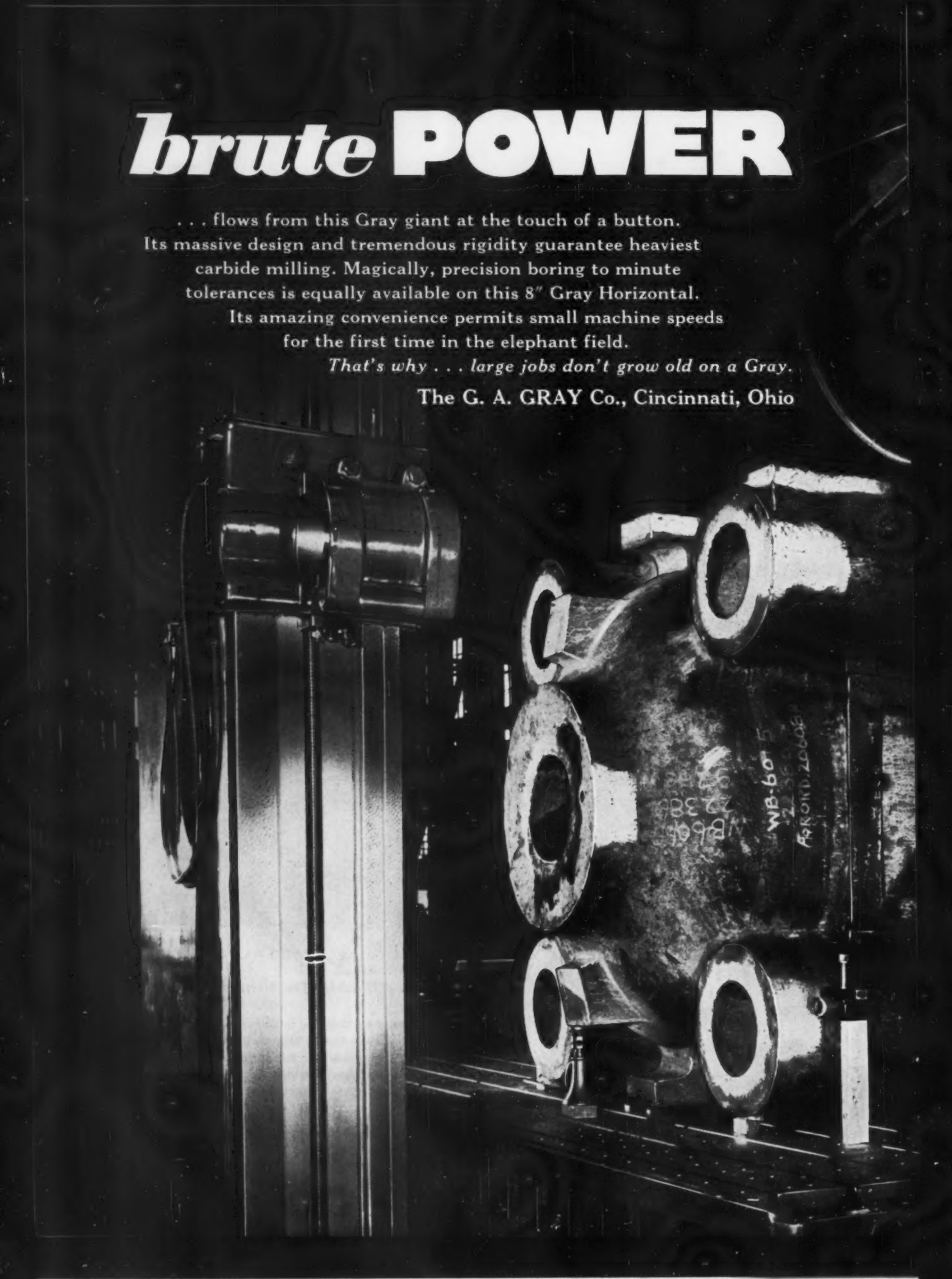
For full information on great new CIMPERIAL and the complete family of CIMCOOL Cutting Fluids, call your CIMCOOL Distributor today. Or contact Cincinnati Milling Products Division, Cincinnati 9, Ohio.

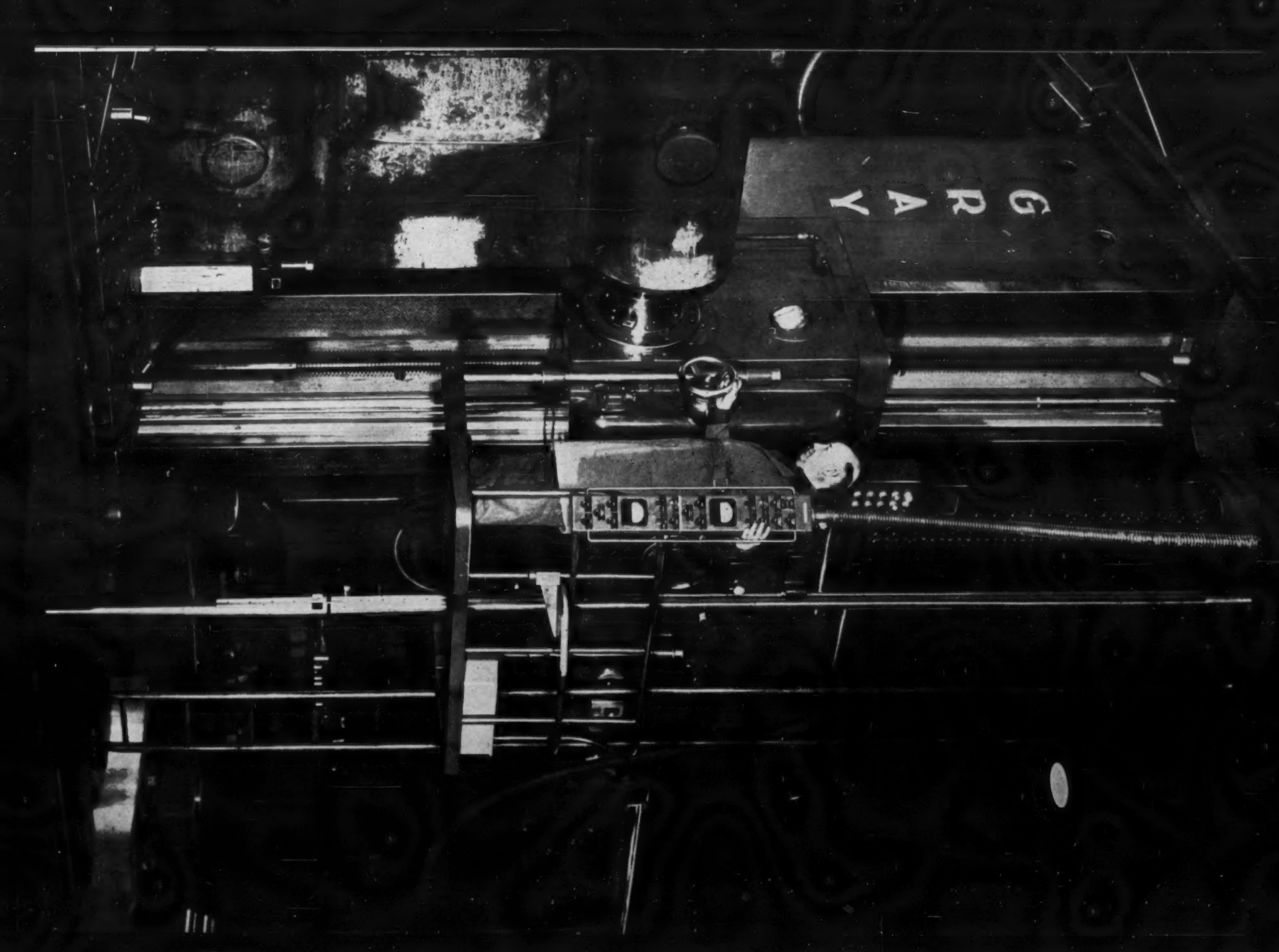
° Trade Mark Reg. U. S. Pat. Off.

brute POWER

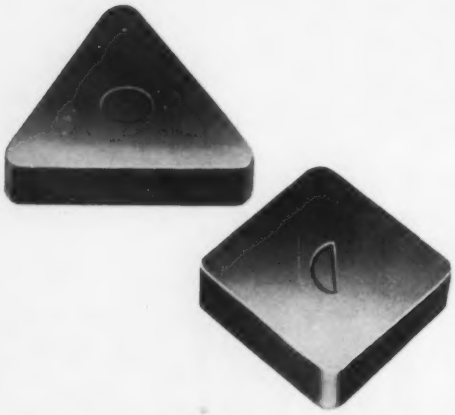
. . . flows from this Gray giant at the touch of a button.
Its massive design and tremendous rigidity guarantee heaviest
carbide milling. Magically, precision boring to minute
tolerances is equally available on this 8″ Gray Horizontal.
Its amazing convenience permits small machine speeds
for the first time in the elephant field.
That's why . . . large jobs don't grow old on a Gray.

The G. A. GRAY Co., Cincinnati, Ohio




YARG

165 CARMET INDEXABLE SQUARE CARBIDE INSERTS WOULD COVER THIS PAGE



THAT'S

1320 New, sharp cutting edges for about 10¢ each to do almost all metal cutting jobs

THEY'D REPLACE

1320 Individual, brazed single-point tools.
No tool regrinding.
Minimum tool changing.

Over 118 styles and sizes of Indexable Inserts to use in Carmet high-alloy, cadmium plated Tool Holders in both positive or negative rake types.

Write for new Catalog C-16

CARMET CEMENTED CARBIDES FOR INDUSTRY

This 32-page first edition contains prices and complete specifications on Carmet's full line of cemented carbide tipped tools, Indexable Inserts, blanks and holders. Speed and feed charts, grade comparisons and ordering information included.

ADDRESS DEPT M-13

Why not find out more about Carmet Indexable Inserts and the complete line of Carmet cemented carbide tools and standard blanks? Your Carmet distributor carries them in stock, assures prompt delivery and will aid you in selecting the proper grades and styles to cut your metalworking costs. Call him today or write Allegheny Ludlum Steel Corporation, Carmet Division, Detroit 20, Michigan.

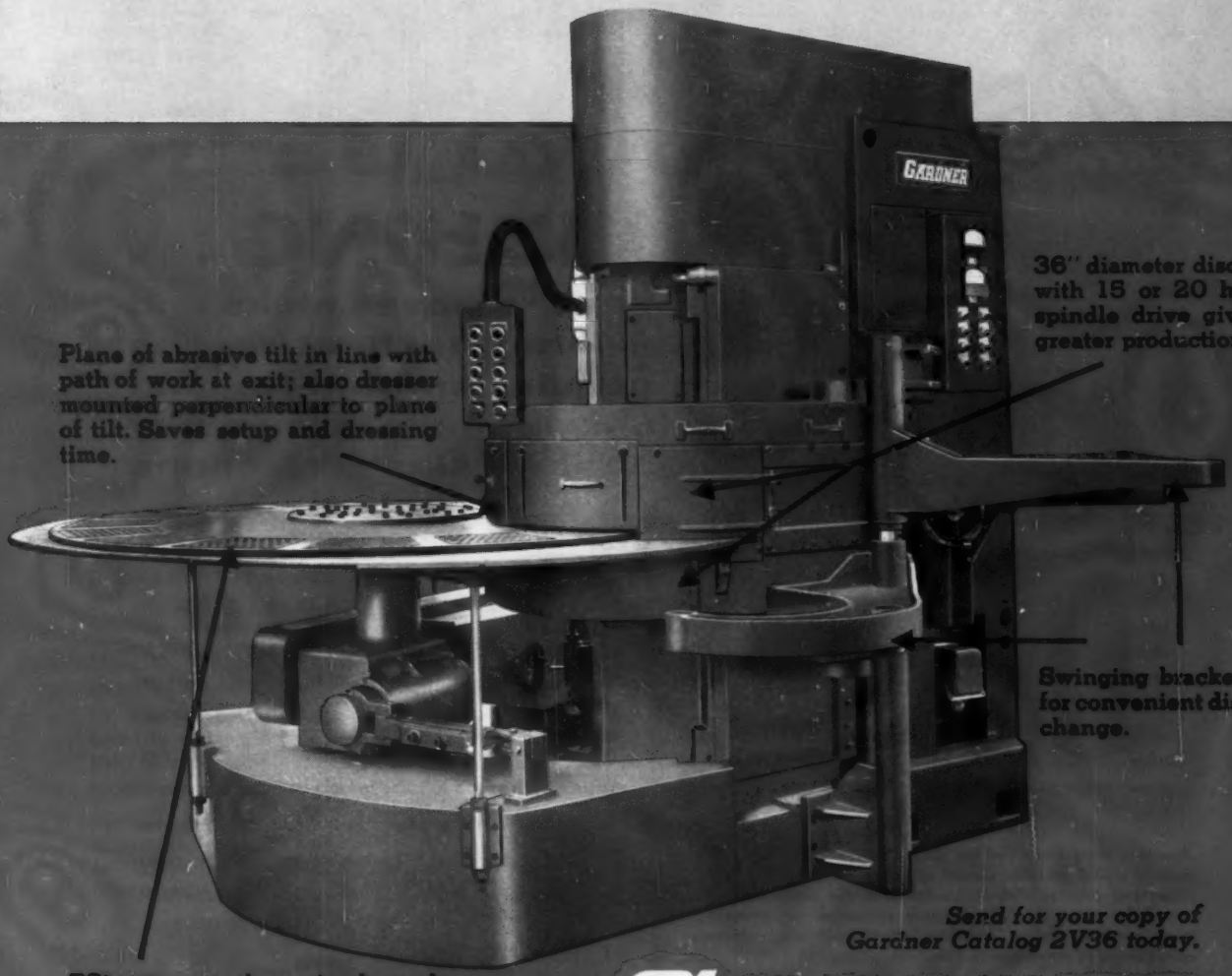
WSW-7323

CARMET

CEMENTED CARBIDE DIVISION OF
ALLEGHENY LUDLUM STEEL CORPORATION

new Gardner 2V36 double vertical spindle grinder

grind TWO parallel surfaces in ONE operation



Plane of abrasive tilt in line with path of work at exit; also dresser mounted perpendicular to plane of tilt. Saves setup and dressing time.

36" diameter discs with 15 or 20 hp spindle drive give greater production.

Swinging brackets for convenient disc change.

78" rotary work carrier has adjustable oscillation; discs stay flat longer and workpieces have greater accuracy. Also saves time when dressing because work carrier swings outward and need not be completely unloaded.

Send for your copy of Gardner Catalog 2V36 today.

GARDNER

precision disc grinders

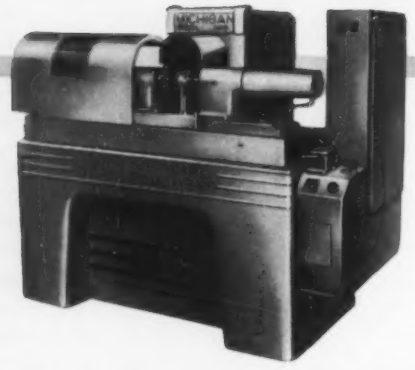
BELOIT, WISCONSIN

The finishing action—an abrasive tool rotates in tight mesh (and drives) the hardened work gear in a crossed-axes relationship. The table traverses the work the full face width.

Grit content of the abrasive-plastic tool varies with application. Relatively inexpensive, the throwaway tools actually become even more accurate as they "wear in".

Announcing HARD GEAR FINISHING...

...new process removes nicks and surface imperfections after heat treating to give you quiet, smooth-running gears. Uses long-life throwaway tools to slash rejections



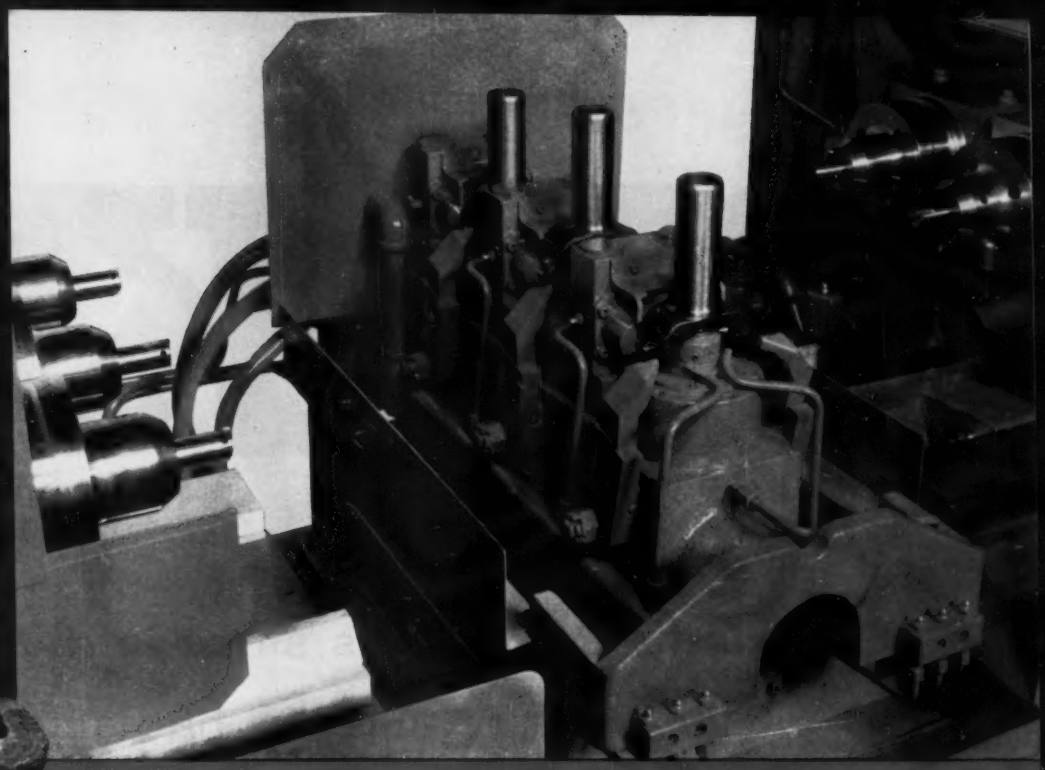
Abrasive Hard Gear Finisher (Model 999), a compact, functionally styled machine cleans up and silences hard gears in about one minute. With horizontal axes, the finisher is easily tooled for semi- or full-automatic operation. An integrated gear speeder and/or crowning attachment are optionally available with the machine.

Now you can obtain consistent quietness and smoothness on your hardened small- and medium-sized gears (up to 12-inches diameter). Michigan Tool's Abrasive Hard-Gear Finisher does the job quickly and effectively at low cost. It uses amazingly long-life abrasive-impregnated tools to remove nicks and burrs, improves finish, and tightens dimensional accuracy by further refinement after heat treat. It all adds up to quiet, lower cost gears. Full details in Bulletin 999. Write for it.

MICHIGAN TOOL Company

from blank to finished gear

7171 E. McNICHOLS RD., DETROIT 12, MICH., U.S.A.
IN CANADA: COLONIAL TOOL CO. LTD.



RIGHT: Vertical splined arbors and clamps holding shoulders of bores are operated hydraulically.

BELOW: Universal yoke showing two holes bored simultaneously.

Two-Way Boring Speeds Parts Production

58-9

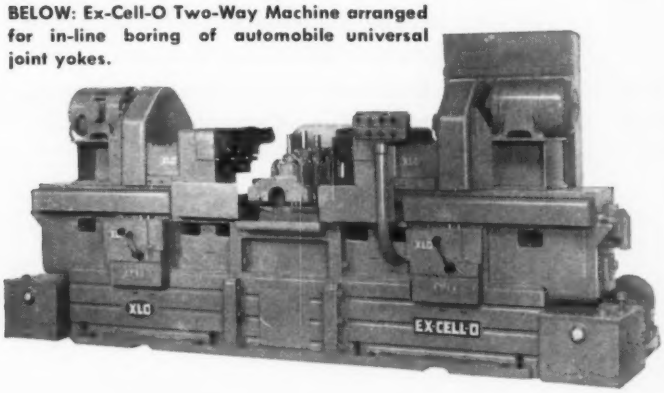
This Ex-Cell-O Precision Two-Way Boring Machine cuts production time of universal yokes for a manufacturer of automotive components by performing operations at both ends of a part—simultaneously.

Two independent machines interlocked electrically for central push-button control, the two-way unit bores two holes in line through malleable iron yokes held in a three station fixture. Both machine sections have three spindles on each slide for high production.

Two, three or four standard, self-contained way units can be easily arranged around a fixture at any angle the work requires. And like all Ex-Cell-O Precision Boring Machines, Way Machines are readily adaptable to different size workpieces—light, medium or heavy parts—and varying material requirements.

For complete information on versatile Ex-Cell-O Way Machines that can save time in your operation, contact your local Ex-Cell-O Representative, or write direct.

BELOW: Ex-Cell-O Two-Way Machine arranged for in-line boring of automobile universal joint yokes.



XLO EX-CELL-O FOR PRECISION

EX-CELL-O CORPORATION

DETROIT 32, MICHIGAN

Machinery Division

MANUFACTURERS OF PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • TORQUE ACTUATORS RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

How

RYKO

In just two years since introduction, **RYKON** Grease has stepped in to deliver lubrication in hundreds of applications where other greases have failed

The reason RYKON Grease can perform under conditions that cause other greases to fail is this: RYKON Grease has a unique non-soap, organic thickener. This thickener holds the oil between its fibers better than any other gelling agent. The thickener is able to withstand extremely high as well as low temperatures. It resists chemical action and remains stable under conditions of severe working and water washing. RYKON Grease has exceptional anti-rust properties.

RYKON Grease's unique properties make it truly multi-purpose. This leads to many worthwhile economies. With one grease to do possibly every grease lubrication job in a plant, there's no chance for application mistakes. Inventory and handling of many single-purpose greases is reduced or eliminated. Maintenance training and supervisory follow-up is greatly reduced.

More facts about RYKON Grease are yours for the asking. Call the lubrication specialist in your nearby Standard Oil office in any of the 15 Midwest and Rocky Mountain states. Or write **Standard Oil Company (Indiana), 910 S. Michigan Ave., Chicago 80, Illinois.**

N GREASE

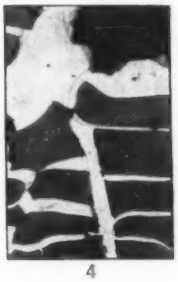
High temperature test for grease. Grease samples are spread on metal strips and placed in 350° F. oven for five days. Only RYKON Grease remained workable at end of test.

has performed in ten tough applications

1

2

3



4

In the metalworking industry, where higher speeds, loads, temperatures and pressures are being put on bearings as a means of increasing productivity of equipment, a new type of grease has been needed. RYKON is that grease. Here are just 10 examples of how RYKON Grease has performed in tough spots:

Industry	Equipment	Type of Bearings	Conditions	Remarks
Steel Mill	various	plain and anti-friction	high temperature, heavy load, water, dirt	Outperforms all previously used greases. Less consumption, fewer bearing failures.
Steel Mill	tin line	plain and roller	high temperature, water	Hot caustic water caused other greases to run out and form deposits. RYKON lasts twice as long.
Metalworking	bearings over molten pot	—	high temperature	Temperature reaches 500° F. at times. RYKON stays in longer.
Steel Mill	pit crane, floor crane, charging car	plain and anti-friction	high temperature	Lasts twice as long as some other greases used.
Metalworking	drill head multi-spindle	anti-friction	heavy load	Other greases failed. Running cool on RYKON. No leakage.
Auto Manufacturer	switches on machine tools	—	wet	Good water protection and dielectric strength at a lower cost than previously
Die Caster	die cast machines	various	high temperature	Cut down wear considerably.
Bearing Manufacturer	high speed spindle bearings	anti-friction	high temperature, heavy load	Lasts twice as long as a high priced bearing grease. Does not darken or form varnish.
Steel Fabricator	core oven conveyer	pulley bearings	high temperature and dirt	Works where other greases ran out. RYKON best ever used.
Steel Fabricator	oven conveyer	ball	high temperature	All previous greases caused trolley bearings to stick. RYKON solved problem.

Oven test shows high temperature performance of RYKON Grease. 1. Metal panel coated with RYKON and placed in oven at 350° F. 2. Same panel after five days. RYKON is still soft and ready to lubricate. 3. Another high-melt grease ready for same test. 4. Same panel after oven test Grease has failed completely.

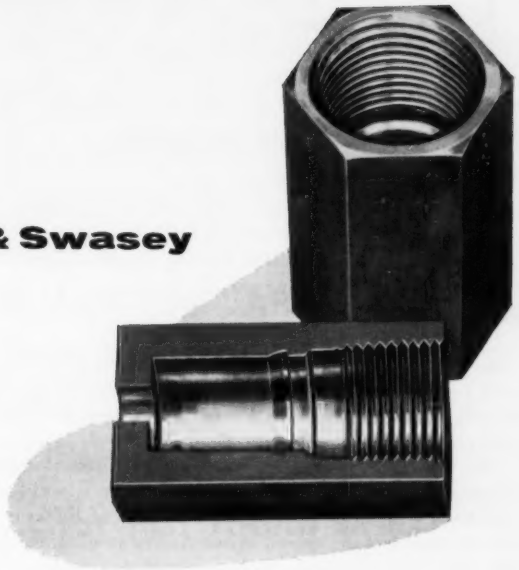
You expect more from **STANDARD** *and you get it!*

Here's how the new No. 4 permitted an improved machining method on the "bottom checks"... B-I-F's older machines had hand-operated collet chucks and bar feeds which required a turret station for a stock stop. In addition to the stock stop, six additional turret faces were required for the tooling, but only five stations were open. This meant that a quick change holder had to be placed on one turret face. For each part produced, a manual exchange of tooling had to be made in this one turret station. This was not only a fatiguing operation, but occasionally confused the operator as to which tool was in place, resulting in an occasionally scrapped part.

However, longitudinal feeding accuracy of the No. 4's hydraulic bar feed eliminated the need for a hex turret stock stop and thus opened up one more face on the turret—eliminated the hand exchange of tooling.

At B-I-F INDUSTRIES, INC.

Providence, Rhode Island



Modernization with Warner & Swasey No. 4 Turret Lathe saves FOUR minutes per piece on this "Bottom Check"

In this case, the new machine permitted an improved tooling method which combined to reduce first operation machining time from 10 to 6 minutes!

At B-I-F INDUSTRIES a wide variety of jobs are machined in lot sizes varying from 50 to 200 pieces—some special runs require only 3 or 4 pieces. Materials machined cover an equally broad range—from free-machining brass to various grades of stainless, Monel and Hastelloy.

B-I-F made a 31-week study of the new No. 4 versus their older No. 4's. The result showed substantial production increases on all types of machining jobs.

Machine features helping to effect these production time and cost savings include:

- **Handling ease of the machine—each model Warner & Swasey is individually designed for a specific range of work.**
- **Ease and simplicity of speed preselection and engagement—new all-clutch headstock design encourages use of the correct speed for every cut.**
- **Ability of the No. 4 to hold tolerances from .0005 to .001-inch total—helped eliminate subsequent finishing operations.**
- **Vibration-free running of constant mesh gear train headstock—substantially improved cutter life, permitted 32 to 63 micro-inch surface finishes to be easily held.**

Check today with your Warner & Swasey Field Representative and see how these versatile No. 4 Ram Type Turret Lathes can fit into your production picture—increasing production, boosting profits.

WARNER & SWASEY
Cleveland
PRECISION MACHINERY SINCE 1880

YOU CAN PRODUCE IT BETTER, FASTER, FOR LESS...WITH A WARNER & SWASEY

For more data, circle this page number on inquiry card

Bill Lenkeit tells why his Jig Boring and Jig Grinding Room is "all-Moore"

This is another in a series featuring the views of owners of leading contract tool and die companies

by **WILLIAM LENKEIT**
President
Lenkeit Machine & Tool Co., Inc.
Farmingdale, L. I., N. Y.
Precision Tooling, Contract Jig Boring and Jig Grinding

"Like other modern contract plants where close-tolerance work is the rule, we have a special air-conditioned room housing our jig borers and jig grinders. In ours, the nameplate on every machine reads 'Moore.'

"We have always sought to obtain the best possible equipment for each type of operation. That is why our facilities list includes outstanding machines of Swiss and German manufacture, as well as fine American-made equipment. But when it came to jig boring and jig grinding, we found there was no equal to Moore machines for built-in accuracy, versatility and ruggedness.

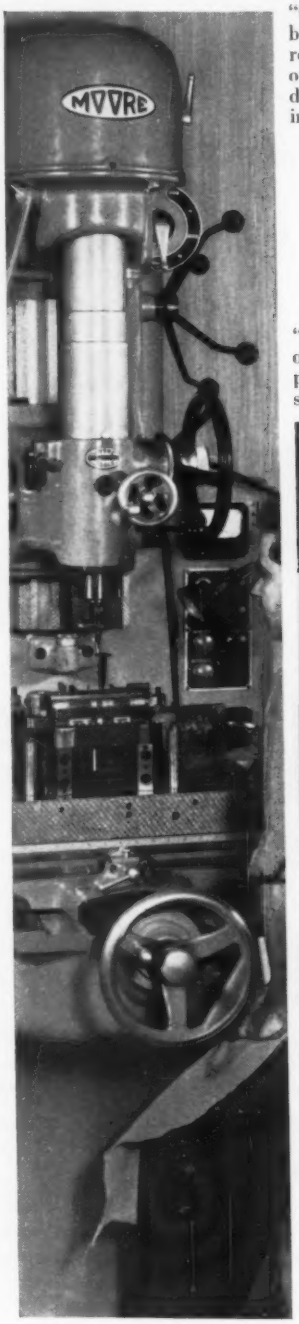
"We now have three Moore jig borers and one Moore jig grinder, with another borer on order. We use this equipment extensively for operations on the precision dies, jigs, fixtures and inspection gages we build for leading Eastern companies in the instrument, electronics, electrical and printed-circuits fields. We also do a considerable amount of contract jig boring and jig grinding for instrument companies which naturally have close-tolerance requirements.

"What do we like best about our Moore equipment? These machines are ideally suited to our day-to-day toolroom work—quick setups, convenient controls and, most important of all, unmatched accuracy. Our machines have been in almost constant use since they were installed and they are just as reliable as ever.

"Our all-Moore facilities for jig boring and jig grinding are a major reason why we can say: 'It pays to tool it right at Lenkeit'."

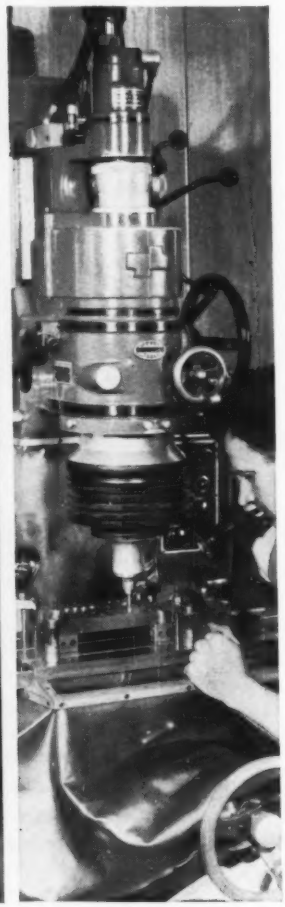
MOORE SPECIAL TOOL COMPANY, INC.
734 Union Avenue, Bridgeport 7, Connecticut

HOLES, CONTOURS AND SURFACES, Moore's authoritative book, tells how to produce tools, dies and precision parts the modern way. 424 pages, 495 illustrations. $5 in U.S.A., $6 elsewhere.



"One of the three Moore jig borers in our air-conditioned room. They carry the load on our critical spotting, boring, drilling, reaming and checking operations."

"Our Moore jig grinder is one of the key machines in our plant. We especially like its slot-grinding ability."

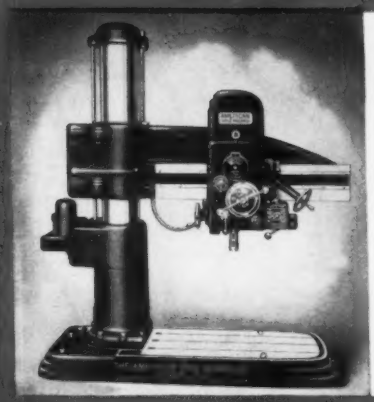


ADD MOORE TOOLS TO YOUR TOOLROOM

JIG BORERS • JIG GRINDERS • PANTOGRAPH WHEEL DRESSERS • PRECISION ROTARY TABLES • HOLE LOCATION ACCESSORIES

?

Are you really putting your small radial drills to work...OR... are they just drilling machines



If they are "AMERICAN" Hole Wizards they are DRILLING...TAPPING and BORING MACHINES

...not just radial drills!

To further improve their boring qualities the new "AMERICAN" 9 inch and 11 inch column Hole Wizards now may be equipped with a FINE FEED BORING ATTACHMENT.

This attachment, furnished in addition to the standard feeding mechanism, merely by the flip of a lever reduces the standard feed range 75 per cent.

The fine boring feeds thus provided are the answer to precision boring on radial drills. Many tool and die shops are already using them for high precision, fine finish boring of jigs and fixtures.

And don't overlook the advantages of the Hole Wizard's Helical Gear—Lo-Hung Spindle Drive —NITRIDED SPINDLE AND SLEEVE—TIMKEN MOUNTED WITH OUTSIDE ADJUSTMENT FOR SPINDLE BEARINGS.

These exclusive "AMERICAN" features permit putting your radial drills to work at a profit.

- ***Ask for bulletin No. 325 and get all the facts.***

THE AMERICAN TOOL WORKS CO. Cincinnati 2, Ohio, U.S.A.

LATHES AND RADIAL DRILLS

Drilling Time Reduced 50%

BURGMASTER *tape controlled*

with automatic numerical

The Burgmaster G. E. Tape Controlled Turret Drill is installed in an air conditioned dark room for exposing the film for making etched copper circuit boards. The tape reader and control cabinet are mounted outside the dark room.

General Electric Company, Phoenix, Arizona, Computer Department, not only cut drilling time 50% in manufacturing printed circuit boards, but actually eliminated 124 expensive fixtures that would have cost six times the machine investment. Approximately 2400 holes of three sizes are drilled in 124 different panels at the rate of 15 to 20 holes per minute, holding ±.002" tolerances between holes.

Burgmaster Plays a Double Roll

Not only is the Burgmaster Tape Controlled Turret Drill used for drilling the panels, but it is also used for exposing the film from which the etched circuit board is made. Computer engineering techniques were used to determine wire tables—the least distance of wiring runs—for programming a punched tape for exposing the negative automatically on the Burgmaster, using a light source as a tool on the turret, and finally, for programming the punched tape for drilling the holes automatically. This unique manufacturing and engineering method greatly reduced the engineering time, and lead time to get into production, in addition to cutting machining time 50%. No complete engineering drawings were required for making expensive tooling and it was estimated that three engineers did the

Programming and Tape Preparation Manufacturing personnel transpose drawing decimal dimensions to a program sheet including feeds, speeds, spindle sequence, and any auxiliary functions. A typist then prepares the standard eight hole punched tapes in a matter of minutes and checks it for accuracy from a typed tape produced at the same time. Duplicate tapes can be produced in seconds automatically, and new instructions (representing design changes) can be spliced in at any point.

JOB FACTS:

Machine	Burgmaster G. E. Tape Controlled 6 Spindle Drill.
Parts	124 Different Etched Copper Circuit Boards
Material	Copper Clad Epoxy Glass 15" x 26" x .093" Thick
Operations	Drill .029, .052, and .193 Holes
Rate of Drilling	15 to 20 Holes per Minute—3 Shifts
No. of Holes	Approximately 2400 per Panel
Accuracy Required	±.002" between Holes
Fixture	Simple Clamps, Corner Location

Specialists in High Production Turret Drilling

1C Manual Power Index 3/8" Capacity

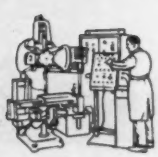
2B Manual Power Index 3/4" Capacity

2BF Flange Mounted Power Index 3/4" Capacity

2BH Automatic Hydraulic 3/4" Capacity

3BH Automatic Hydraulic 1½" Capacity

2BR Ram Type Radial Drill 3/4" Capacity



2BHT—3BHT Automatic Tape Controlled 3/4" and 1½" Capacity

124 $1500 Fixtures Eliminated

6 Spindle Turret Drill

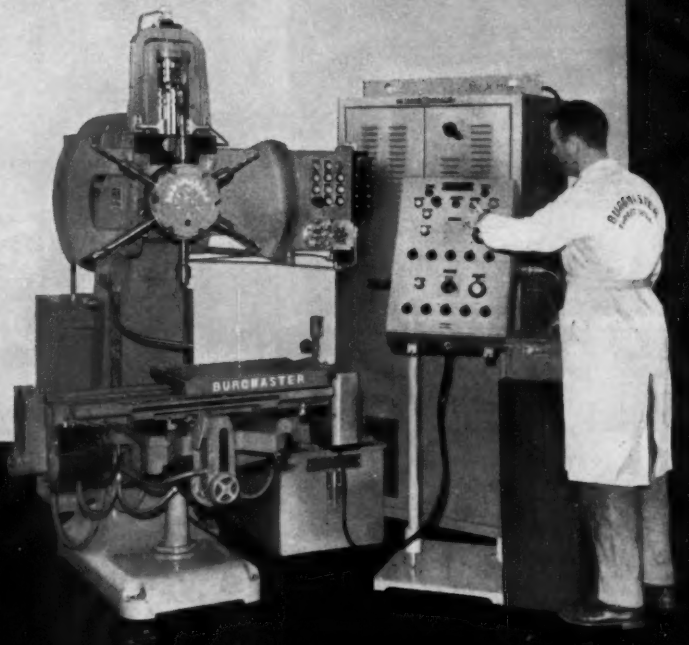
table positioning control

work of thirty engineers and produced far more accurate results—faster.

Maximum Flexible Automation

The application of G.E. Numerical Controls to either Standard Burgmaster 6-spindle or 8 spindle turret drilling, tapping and boring machines results in maximum flexible automation. That is, *these field proven Burgmaster machines* can be quickly and economically set up to produce a large variety of parts using standard tools and simple holding clamps. The standard adjustable Burgmaster controls are maintained... including pre-selective spindle speeds, infinitely variable pre-selective feeds, selective rapid approach and return, skip indexing, precision depth control, and simple manual controls for set-up. The G.E. numerical system controls all machine functions, selects spindles in any sequence, automatically positions the table on two axes, clamps the table while machining operations are performed, and controls coolant. Up to six different operations can be performed at any command position without moving the table, or as many cycles using one tool as desired, without indexing. All operations are carried out at their most efficient rate for high finish, precision, speed, and longest tool life. As a result one man can operate two or more machines on many jobs, or by attaching two tapes together one part can be machined on one end of the table while work is being set up on the other to effect constant machine operation.

The savings that can be realized from Automatic Tape Controlled production on small lots or high production is tremendous. Why not get all the facts on your work? There is a Burg direct representative or dealer near you. Call him —there is no obligation.

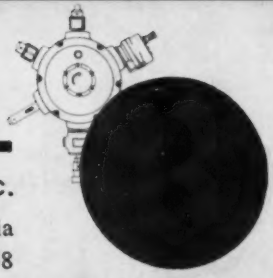


This is a general view of the entire automatic manufacturing unit comprising the Burgmaster 6 Spindle turred drill, G.E. tape control unit, control cabinet and tape reader. Price, $29,000 complete. G.E. Tape Control can also be applied to the Burgmaster 8 Spindle Turret Drills. Capacities are ¾" and 1½" in steel, tables 10" x 18" and 18" x 30". Larger automatic positioning tables also available.

Alternate Method. Using Expensive Drill Jigs (Estimated cost $1500 ea.) and Semi-Automatic Multi-Spindle Drills.

Savings. . 50% Reduction in Drilling Time—124 $1500 Fixtures Eliminated, 3 Engineers Instead of 30 Using Computer Techniques—greatly reduced lead time.

Write for Bulletin describing Burgmaster 6 and 8 Spindle Tape Controlled Turret Drilling, Tapping, and Boring Machines. Thirty-minute 16mm sound film showing all Burgmaster Turret Drills in operation is available from any office without charge.



BURG TOOL

MANUFACTURING COMPANY, INC.

15001 South Figueroa Street, Gardena, California

FAculty 1-3510 DAvis 9-4158

BURGMASTER DIRECT SALES OFFICES:

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LIncoln 8-4333

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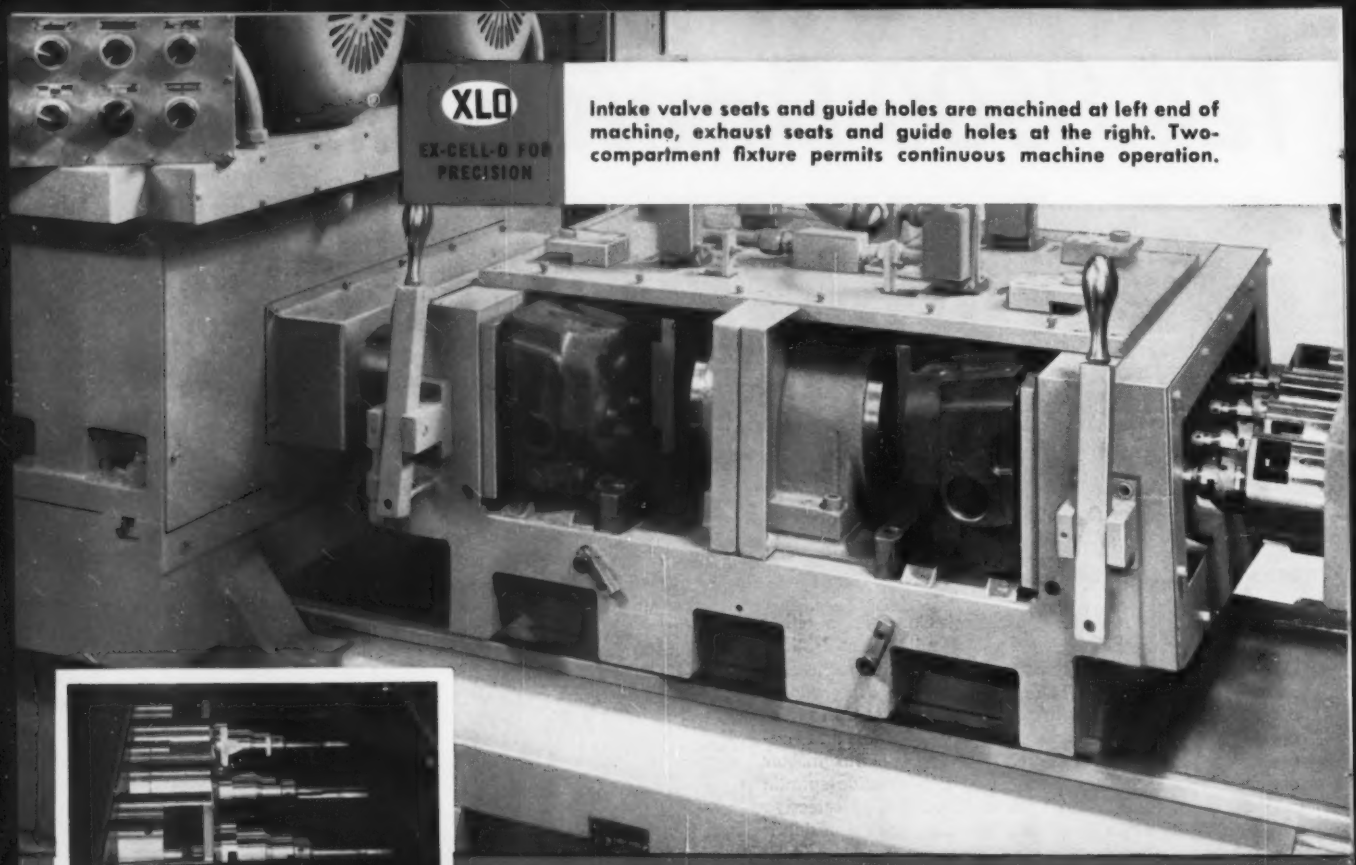
Belmont, Calif.
LYtle 1-0309

Plus dealer representatives in other industrial centers.



Intake valve seats and guide holes are machined at left end of machine, exhaust seats and guide holes at the right. Two-compartment fixture permits continuous machine operation.

Gun-type drills extend through spindle centers and retract automatically

CONCENTRICITY GUARANTEED

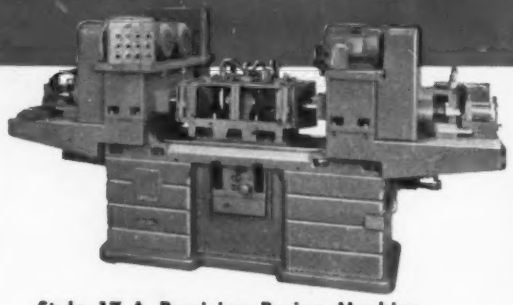
58-10

Bor-Drils valve guide holes and plunge-faces valve seats in one operation

A Standard Ex-Cell-O 17-A Precision Boring Machine, equipped for the Bor-Dril process, is turning out 23 cylinder heads per hour for a large auto manufacturer.

The table rapid-traverse feeds cylinder heads to the left into four cutters that plunge-face intake valve seats, then retract .020". Next, four gun-type drills advance through the spindle shafts to Bor-Dril guide holes from the solid—with guaranteed concentricity. The table then moves to the right, repeating the process on exhaust valve seats and guide holes.

Find out how the Bor-Dril process can help speed production in your plant; contact your local Ex-Cell-O Representative, or write direct.



Style 17-A Precision Boring Machine equipped for Bor-Dril process drills deep holes from the solid with guaranteed accuracy.

EX-CELL-O
CORPORATION
DETROIT 32, MICHIGAN
Machinery Division

MANUFACTURERS OF PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • TORQUE ACTUATORS RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

A-B QUALITY Reliable Control Units

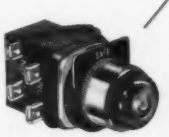
for every industrial application

Among the many hundreds of Allen-Bradley push button and control units, you are certain to find the types best suited to your particular needs. The seven units shown below are a few of the latest additions to the Allen-Bradley *quality* line of control units.

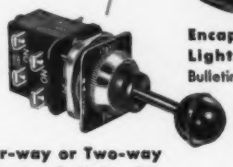
All Allen-Bradley control units—standard duty, heavy duty, and oiltight—have double break, silver alloy contacts—to assure reliable operation. Simple constructions and generous wiring room are outstanding features. Insist on Allen-Bradley control units for *all* of your equipment—you can't go wrong!

NEW

Illuminated Push Button. Combines pilot light and push button in one unit. Oiltight Bulletin 800T.



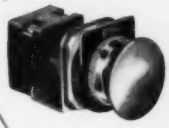
Push-to-Test Pilot Light. Oiltight Bulletin 800T.



Four-way or Two-way Selector Switch. Oiltight Bulletin 800T.

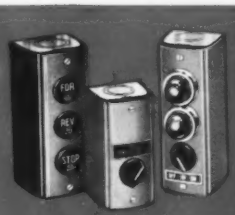
Encapsulated Pilot Light. Heavy Duty Bulletin 800.

Encapsulated Pilot Light. Oiltight Bulletin 800T.



Time Delay Push Button. Delay is adjustable from 0.5 second to 5 seconds. Oiltight Bulletin 800T.

Double Circuit Push Button. Has 2 N.O. or 2 N.C. contacts. Oiltight Bulletin 800T.



STANDARD DUTY CONTROL STATIONS

HEAVY DUTY CONTROL STATIONS

OILTIGHT CONTROL STATIONS

ALLEN-BRADLEY OFFERS the most complete line of standard duty, heavy duty, and oiltight control stations on the market. Send for Publication 6090 today.

1-59-MR

ALLEN-BRADLEY

MOTOR CONTROL

QUALITY

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

A new "quality" standard for small REVERSING DRUM SWITCHES

A-B QUALITY

GOOD-LOOKING AND GOOD "FEELING" DIE CAST HANDLE

EASILY ACCESSIBLE MOUNTING HOLES

MERELY LOOSEN SCREW AND SLIDE PLATE to change from momentary to maintained contacts —or vice versa

INDEPENDENT SWITCH MOUNTING prevents misalignment

HEAVY CONTACT SURFACES for long operating life

TWO CONDUIT OPENINGS

WRAP-AROUND COVER gives complete access to drum

SINGLE SCREW COVER MOUNTING —screw cannot fall out

ACCESSIBLE SCREW TERMINALS for front wiring

RAISED EDGE for base mounting without spacers

maximum rating 2 horsepower

NEW OILTIGHT COVER PLATE FOR CAVITY MOUNTING

Bulletin 350 Reversing Switch can be furnished with oiltight cover plate with rubber gasket seal for cavity mounting in a machine base.

This *all-new* Allen-Bradley reversing drum switch was designed to keep pace with the mechanical beauty designed into so many of the modern machine tools.

The Bulletin 350 reversing switch is equivalent to a three-pole, double throw switch . . . and can be used with d-c motors; or single phase, two phase, or three phase a-c motors.

Investigate the Bulletin 350 . . . the *new leader* of its class . . . in appearance, ease of installation, and operating life. An Allen-Bradley *quality* switch . . . in every sense of the word. Send for descriptive bulletin.

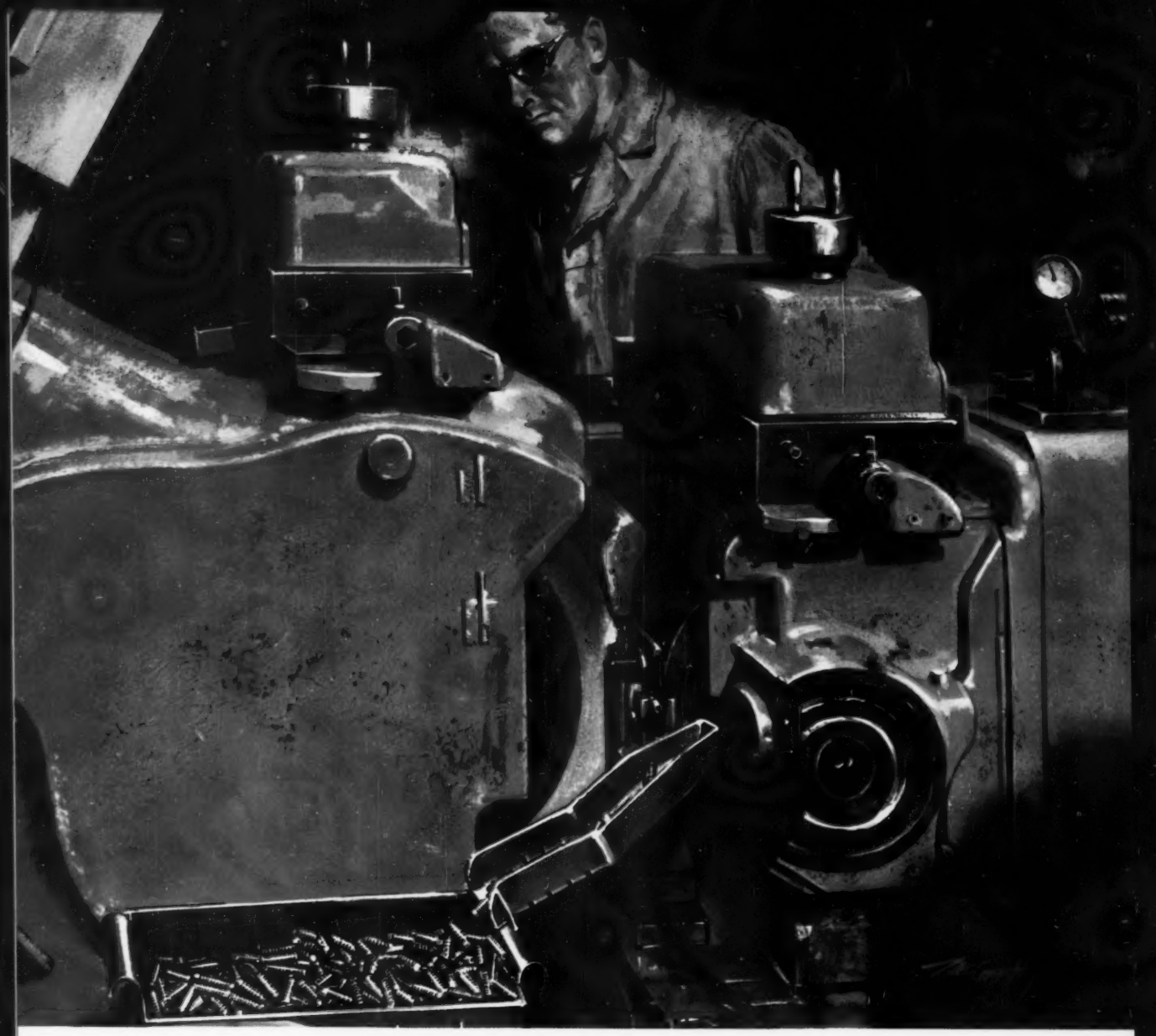
ALLEN-BRADLEY

MOTOR CONTROL

QUALITY

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.
In Canada—Allen-Bradley Canada Ltd., Galt, Ont.

1-59-MR



How 7,000 pieces per hour get the "Touch of Gold"

Here a centerless thread grinder is adding value the most modern way . . . applying the "Touch of Gold" automatically, with a Norton crush-trued wheel that is grinding threads in set screws at an average rate of 7,000 per hour.

You too can benefit by Norton leadership in continually improving grinding wheels and grinding methods . . . which helps proportion your labor, overhead and wheel costs as favorably as possible, so that you can produce with increased efficiency and economy.

Norton stocks more than 200,000 types and sizes of grinding wheels . . . and brings to every industrial area the many products and services that have become synonymous with the "Touch of Gold".

NORTON COMPANY, General Offices, Worcester 6, Massachusetts.

NORTON
ABRASIVES

Making better products . . . to make your products better

why you should put SUPERFINISH in your blueprints

Longer life, better performance—yes, and *lower costs, too*—should be engineered into the product at the start. For example: when you specify Gisholt SUPERFINISH, you accomplish two things: First, you assure a bearing surface free of the imperfections that cause wear—a surface that will last indefinitely. Second, you cut the cost of grinding—or even eliminate it. Surprisingly enough, you can in most cases achieve this superlative finish at lower over-all cost than is possible with other methods of finishing.

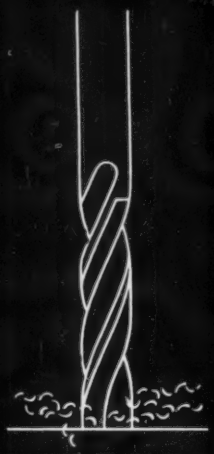
Contains revised material from original textbook "Wear and Surface Finish" plus machine data, job applications and machine floor plans.

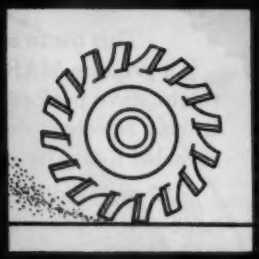
GISHOLT MACHINE COMPANY
Madison 10, Wisconsin, U.S.A.

ASK YOUR GISHOLT REPRESENTATIVE ABOUT GISHOLT FACTORY-REBUILT MACHINES WITH NEW MACHINE GUARANTEE

Gisholt Machine Company
Madison 10, Wisconsin
Gentlemen:
Please send my free copy of new Gisholt Superfinisher Catalog.

Name.....*Title*.....
Company.....
Street Address.....
City.....*State*.....





vega

air-hardening tool and die steel is the easiest to machine of all air-hardening tool steels. Vega was specially developed by Carpenter to combine toughness and the machining properties of an oil-hardening steel with the safety in hardening of an air-hardening grade. It is safe to harden and even intricate dies with many cutouts, sharp corners and thin sections come through heat treatment with outstanding freedom from distortion and size change. Call your local Carpenter Service-Center for immediate delivery from complete stocks.

the *Carpenter* Steel Company, Reading, Pa.

Here's a MARVEL HIGH-SPEED-EDGE Hack Saw Blade we wouldn't sell you!

This blade **could** have been packaged and shipped as a genuine MARVEL High-Speed-Edge Blade . . . and it **might** have performed to a customer's satisfaction. Instead, it was rejected and will be scrapped because inspection revealed a minute imperfection.

There's nothing unusual about this. Certainly, other hack saw blade manufacturers inspect their products, and undoubtedly reject blades for one reason or other, because they are trying to market the best blades they know how to make.

And that's the point—here at MARVEL, where the composite blade was invented and perfected over 30 years ago, we believe we know more about making high-speed-edge hack saw blades than any other maker. We've been at it longer, and the unequalled performance of MARVEL Blades on every kind of material is evidence that we're right.

Use MARVEL Blades on your power hack saws with perfect confidence that they have no equal. You can get MARVEL Blades at your nearby Industrial Distributor.

Write for the new MARVEL Cutting Tool Bulletin.

B-1122

MARVEL Metal Cutting SAWS
Better Machines–Better Blades

ARMSTRONG-BLUM MFG. CO.
5700 W. BLOOMINGDALE AVE. • CHICAGO 39

INNOCENTI

milling and boring machine INNOCENTI C.W.B

INNOCENTI CORPORATION 45 Columbus Avenue
NEW YORK 23, N.Y · Tel. Columbus 5-7798

The Innocenti CWB milling and boring machine allows the solution of the most difficult working problems in the most rational way. This is achieved thanks to the exceptional performances of the machine and to the variety and flexibility of the equipment used with the machine. The face plate of the headstock is patented and is especially designed for the application of a large range of interchangeable heads for any working requirement. Our technicians besides the standard types are in a position to study for you the unit that can accomplish the outmost economy in the most difficult stage of your working operations. Examples of standard equipment: (1) 8 spindle turret head (2) Head for machining diesel engine and moto-compressors (3) Universal head (4) Head for machining turbines (5) Head for machining rotor slots (6) 3 way head

production

flexibility — great accuracy — High

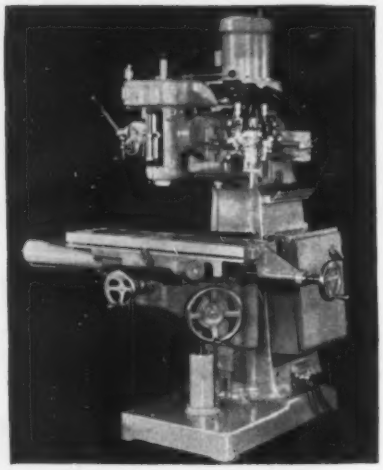
maximum

bertani f2 58

INCREDIBLE? NO!

THESE SAVINGS ARE REAL

GORTON MACHINE TOOLS,
both standard and custom-designed, are today *paying for themselves in record time. Here are just three typical examples:



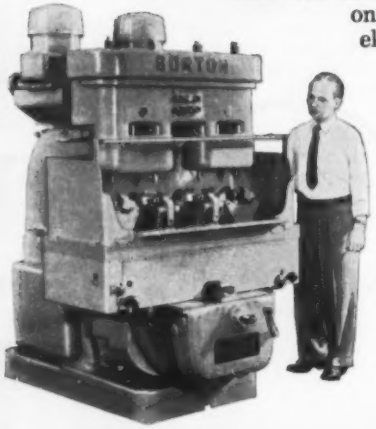
from **8 Hours** per piece
to **5 Minutes** per piece

This standard Gorton Trace-Master Hydraulic Duplicator was purchased to profile a complex part from a simple master. Previous cost of this operation was $102.40. Present cost with this Gorton machine is $1.07. Saving per piece is $101.33.

*Cost figures were arrived at by using $2.80 per hour for operator's time and $10.00 per hour, Machine rate.

cost saving per piece . . . **$1,139.20**

This Gorton Horizontal Mill with special holding fixture, tooling, hydraulics, etc., was purchased to machine thirty-five impeller blades from the solid, involving compound curvatures, thicknesses and depths. Former production time was one piece in 100 hours. Present time on this new machine is one piece in eleven hours. Machine was paid for after machining 22 pieces.



$50,000 machine pays for itself in **41 Weeks**

This Gorton 4-spindle "Automatic Cycle" Duplicator was purchased to mill out recesses in a round steel part. Original production time on a manually operated single spindle duplicator was 60 pieces per hour. Present production on this new machine is 204 pieces per hour. Cost saving is 71%.

Cost reduction and improved accuracy are important to you today. We shall be glad to analyze your needs and make specific recommendations on request.

Your letterhead inquiry will receive prompt attention.

GORTON
SINCE 1893

GEORGE GORTON MACHINE CO.

1301 Racine Street • Racine, Wisconsin

Tracer-Controlled Pantographs, Duplicators — standard and special . . . Horizontal and Vertical Mills, Swiss-Type Screw Machines, Tool Grinders, Small Tools and Accessories.

A8-1012

Now...MORE ball bearing types and a bright, new package

Hoover is widely known as a leading producer of open, shielded and sealed types of deep-groove ball bearings, double row bearings and water pump bearings. These Hoover products have earned a long standing reputation for quality.

Now, three new series are added to the Hoover line: 1) pillow block bearings and companion flange bearings; 2) 3L00 extra light bearings for maximum shaft and minimum housing dimensions; 3) "Super Max" bearings for maximum capacity applications.

All these new bearings meet Hoover's high quality standards. All are made with smooth *Hoover Honed* raceways and *Micro-Velvet* balls, accurate within millionths of an inch. All are designed for superior performance and long life.

New, too, is the distinctive blue and yellow package, designed to help you recognize Hoover bearings quickly and to remind you that they are *tops in quality*.

hoover

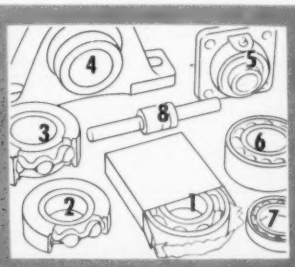
BALL AND BEARING COMPANY

5400 South State Road, Ann Arbor, Michigan

Los Angeles Sales Office and Warehouse: 2020 South Figueroa, Los Angeles 7, California

Chart at Right Identifies Bearings Pictured Above
Use Squares to Check the Information You Want

- ☐ **1** Single Row Deep Groove Bearing.
- ☐ **2** Lubricated-for-life Bearing with Seals of TEFLON*.
- ☐ **3** Cartridge Bearing.
- ☐ **4** Pillow Block Bearing.
- ☐ **5** Flange Bearing.
- ☐ **6** Double Row Bearing.
- ☐ **7** 3L00 Extra Light Bearing.
- ☐ **8** Fan and Water Pump Bearing.



Name _____

Title _____

Company _____

Address _____

City _____ Zone ____ State _____

Hoover Honed and *Micro-Velvet* are Hoover trademarks.
*TEFLON is a DuPont trademark.

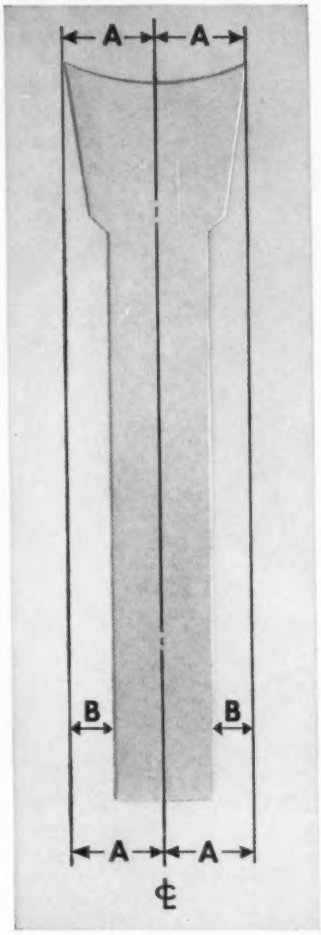
CLEVELAND

Improved MO-MAX® GROUND T-SHAPED CUT-OFF BLADES

can REDUCE YOUR COSTS on all types of cutting-off, grooving and finning operations

MO-MAX High Speed Steel, carefully heat treated by the most modern methods and equipment, provides superior cutting qualities . . . produces *more cuts per grind.*

MO-MAX COBALT High Speed Steel gives best results under difficult conditions . . . has a high degree of red hardness.



The head and body of every blade are ground to close tolerances with reference to the center line, resulting in accurate uniformity and interchangeability.

A new method of grinding these T-shaped Cut-off Blades assures extremely high accuracy in all dimensions. Head and body are always equidistant from the center line. This provides complete interchangeability, and saves costly set-up time.

The top of each blade is ground with a radius, so that the chips are crimped. Chips are narrower than the blade itself, resulting in a cooler running tool, less scoring on the sides of the cut and easier application of coolant.

Try MO-MAX or MO-MAX COBALT T-shaped Cut-off Blades on *your* next job and see how their superior performance reduces your costs. Contact our nearest stockroom or . . .

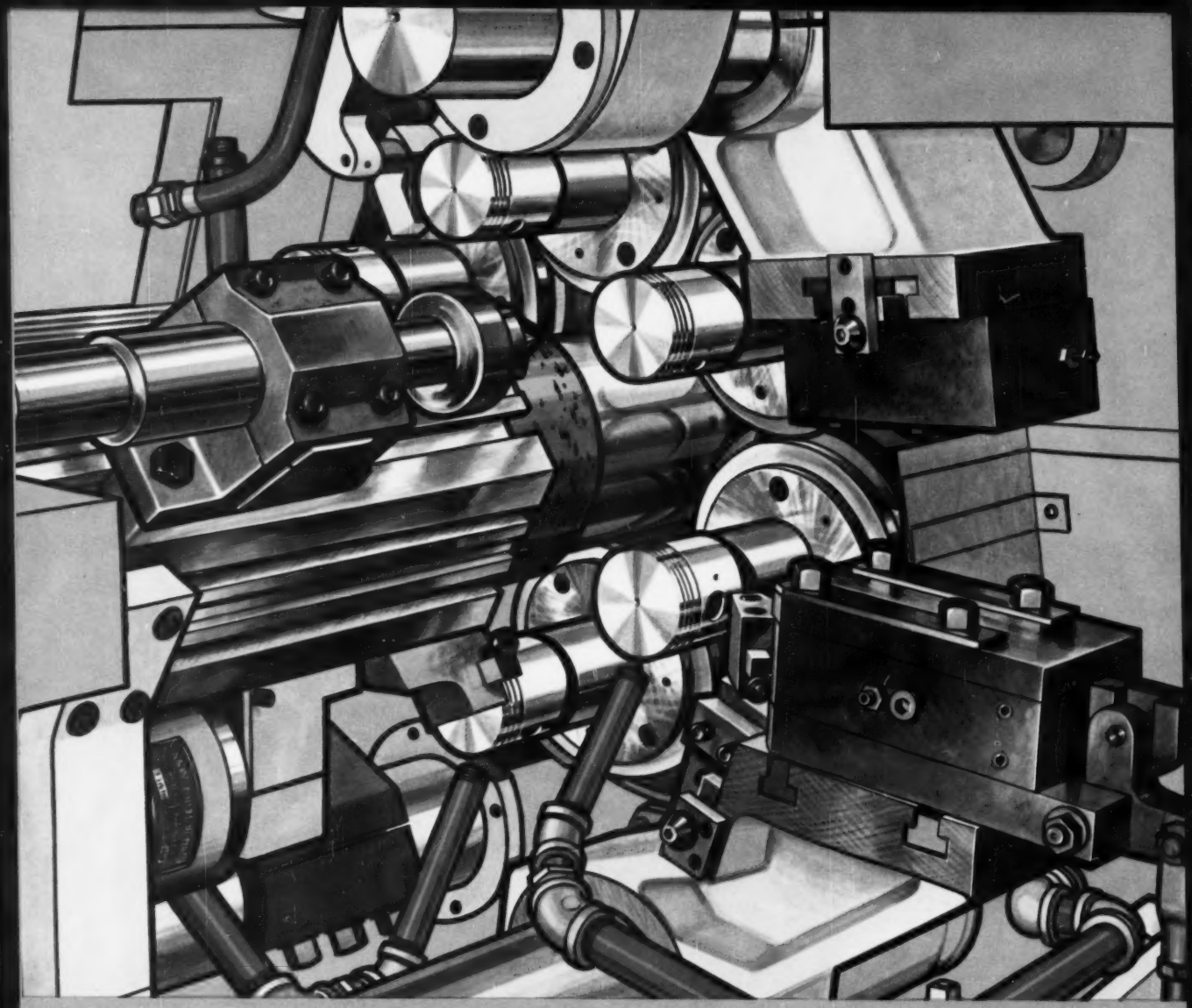
TELEPHONE YOUR INDUSTRIAL SUPPLY DISTRIBUTOR

for CLEVELAND ◇ Quality Tools . . . *prompt delivery from stock*

THE CLEVELAND TWIST DRILL CO.

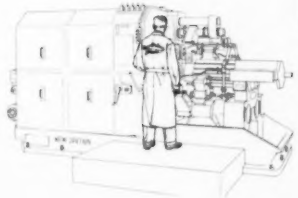
1242 East 49th Street • Cleveland 14, Ohio

Stockrooms New York 7 • Detroit 2 • Chicago 6 • Dallas 2 • San Francisco 5 • Los Angeles 58

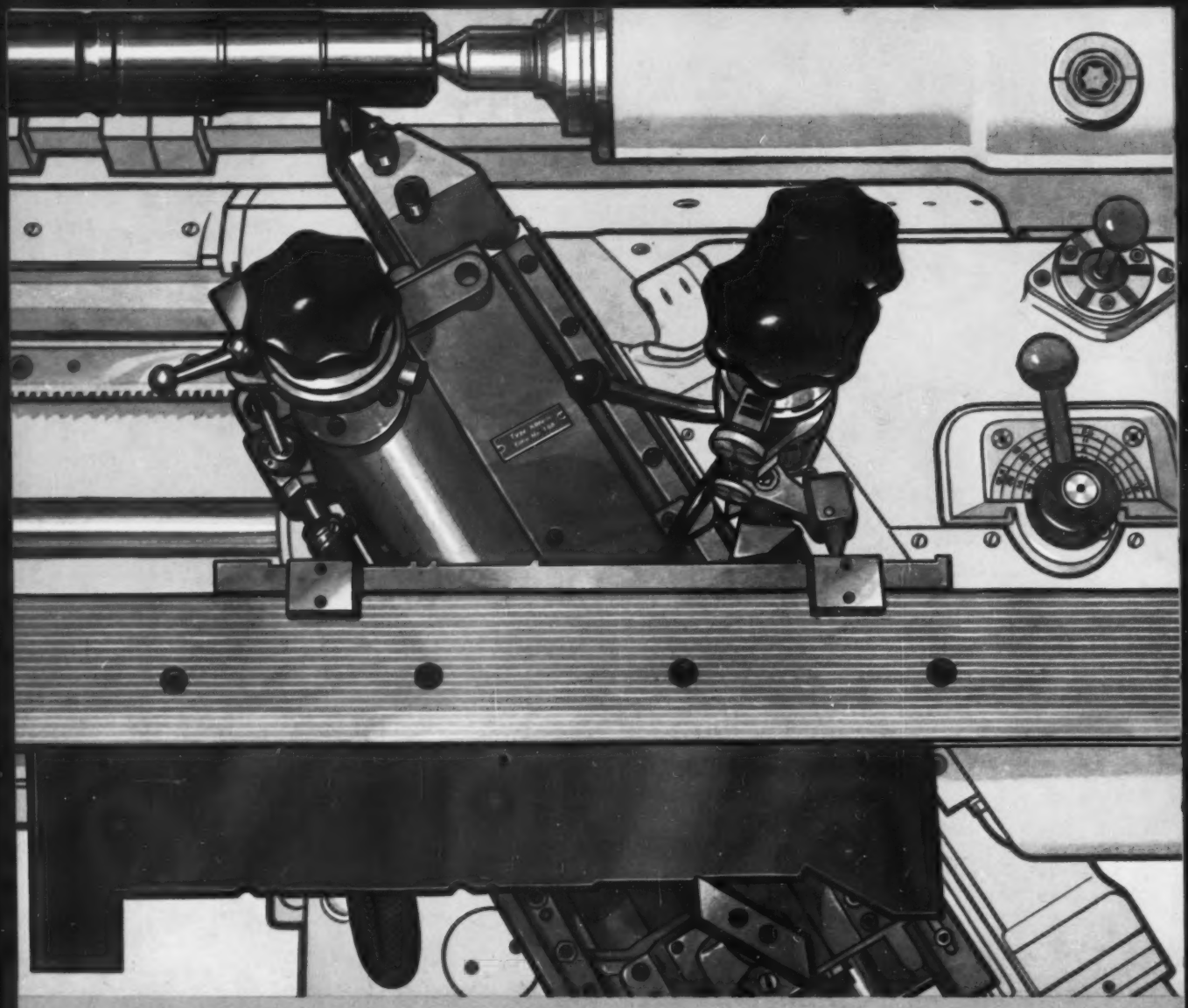


make higher production pay for itself

A New Britain four-, six- or eight-spindle chucker with open-end design, massive forming arms, large capacity (up to 15″) will machine your castings and forgings faster at less cost. You can measure it in *income* instead of *cost* because New Britain Chuckers pay as they go. New Britain's new financing plan makes large initial investment unnecessary. New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Connecticut.



NEW BRITAIN CHUCKING MACHINE



you don't make money adjusting tools

With a New Britain +GF+ Copying Lathe you outproduce gang tool setups because you cut at maximum speeds and feeds for tool efficiency. No tool-wear worries! The single tool is changed in one minute. Every dimension is positively transmitted from template to work, making adjustment a simple matter of bringing one dimension to size — the others *have* to be right. New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Connecticut.

NEW BRITAIN +GF+ COPYING LATHE

a statement about capital equipment investments by G. E. SCHLOOT, *president*

DIAMOND CHAIN COMPANY, INC.
Indianapolis, Indiana

"WE CONSIDER a formal procedure for the justification of capital equipment investments to be an essential element in our constant effort to increase productivity and improve the quality of our power transmission products and the working conditions under which they are produced.

"Proposals, with supporting data, for equipment replacement are received from every segment of our organization and referred to our Industrial Research and Development Division for further investigation. Detailed studies are made to establish the acquisition and operating costs of the proposed equipment, so that our own modification of a MAPI appraisal can be used to establish the economic worth of the proposal.

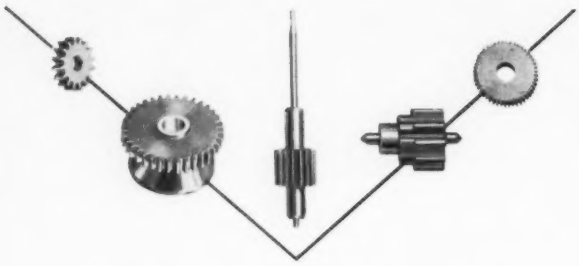
"The costs which must be assigned on the basis of quality or capacity improvement are accurately determined and the related problems, as a result, are more clearly defined. Decisions involving economic improvements resulting from reduced labor, maintenance, and other directly assignable costs are therefore more readily reached.

"This formalized procedure has been quite valuable to us as a means of establishing the relative importance of the various items proposed, for their proper placement in our five-year capital equipment program, and for the intelligent planning of their design, development and installation."

January, 1959

Keep gathering metal-working production ideas . . . be well informed when you replace machinery.

Rockford Insert Group

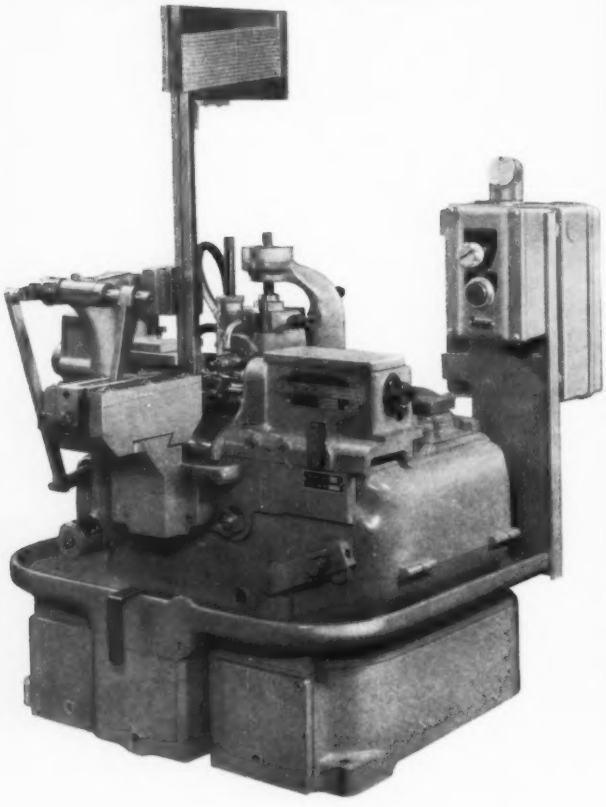


if you cut fine pitch gears
in brass, aluminum, phenolics—

this **new** no. 1-½

hobbing machine

will increase production!



MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

This new No. 1-½ Hobbing Machine is designed with shuttle-type loading and complete automation for hobbing fine pitch watch and clock gears, pinions, meter gears, fuse pinions and similar parts produced in large quantities. It will handle automatically on a production basis many parts too small to handle manually. On such parts cut from brass, aluminum, phenolics — and even some grades of free-machine steel — the machine provides more hobbing efficiency, and increases production over any other equipment presently available. In some cases the machine is also adaptable to hobbing worm gears and helical gears up to 10°.

The new No. 1-½ is a high-speed machine which has been designed to give maximum production flexibility and output. A significant advantage of the machine is its low cost, and for this class of work, figured on a cost-per-piece basis, no other machine presently will compete (including both foreign and domestic).

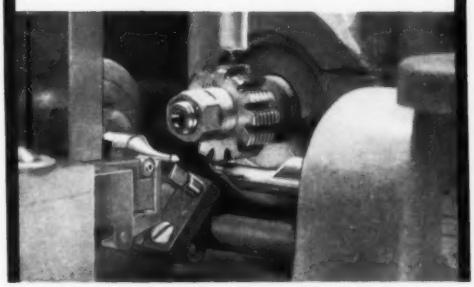
Depending on your production requirements, the machine is available in either standard hob speed range of 666 to 2040 rpm., or high hob speed range of 1332 to 4084 rpm. Shuttle-type loading reduces the automatic cycle time, and adapts the hobbing operation to various standard types of loading devices. Anti-friction bearings are used throughout the machine, and precision adjustments are provided for hob shifting and depth settings. Minimum maintenance and ease of adjustments make the machine a highly dependable production unit.

here's an example!

watch pinion hobbed every 4 seconds

One high speed No. 1-½ Hobbing Machine is producing 6800 watch pinions per 8-hour shift, using shuttle type loading and complete automation. Specifications are:

Brass Pinion — 8 teeth — 56.667 DP
Face Width — .142″ — **Hob** — .915″ x ½″ x .315″
Feed/rev. — .019″ — **Hob Speed** — 3590
Cycle Time — 3 seconds hobbing, 1 second loading
Production — 30,000 pinions per hob shift
120,000 pinions per hob sharpening



Send us your request on company letterhead, and we will send you complete information. Also have your production department send part prints or samples for production estimates.

BARBER-COLMAN COMPANY

121 ROCK STREET • ROCKFORD, ILLINOIS

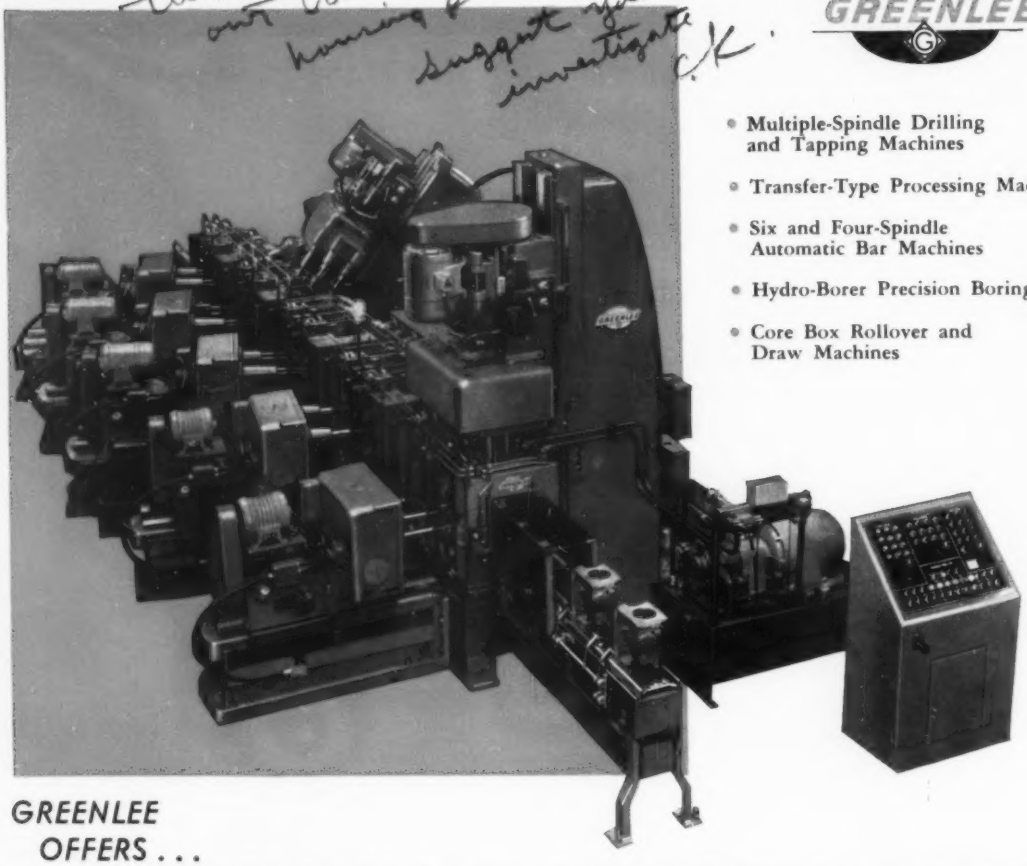
Hobs • Cutters • Reamers • Hobbing Machines • Hob Sharpening Machines

BARBER COLMAN

CITY OF MACHINE-TOOL SPECIALISTS **ROCKFORD, ILLINOIS, U.S.A.**

Sam:
This may solve our transmission housing problems. Suggest you investigate.
C.K.

PRODUCTION MACHINERY
GREENLEE



- Multiple-Spindle Drilling and Tapping Machines
- Transfer-Type Processing Machines
- Six and Four-Spindle Automatic Bar Machines
- Hydro-Borer Precision Boring Machines
- Core Box Rollover and Draw Machines

GREENLEE OFFERS . . .

COOPERATION FOR AUTOMATIC PRODUCTION

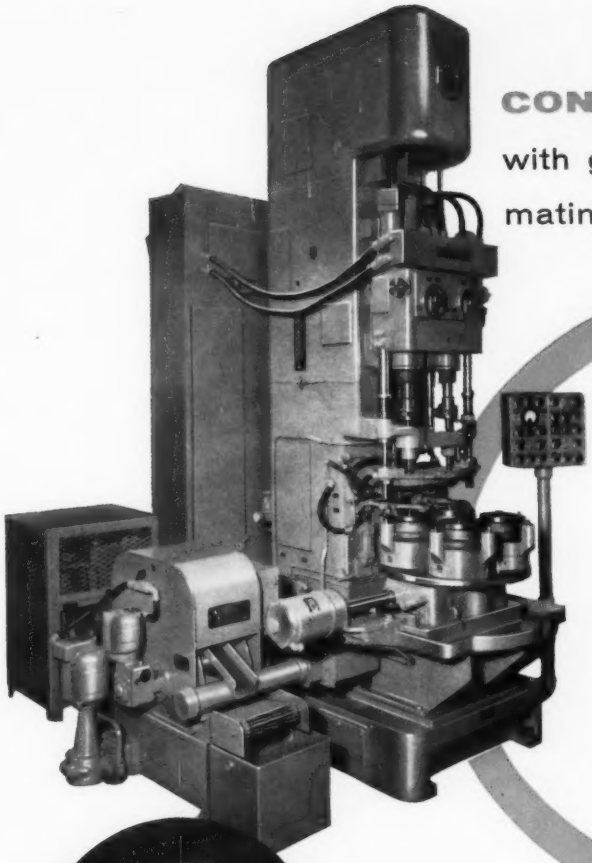
The emphasis is on cooperation at Greenlee. Your ideas are added to Greenlee's. One idea sparks another. The result . . . the creation of machines that will meet your requirements efficiently . . . economically . . . now and in the future. Top-flight Greenlee engineers help you avoid costly mistakes. Their thinking is sound . . . respected. Call Greenlee. Let them give you the complete story on cooperation for automatic production.

MACHINES DESIGNED WITH THE FUTURE IN MIND

GREENLEE BROS. & CO.

1746 MASON AVENUE
ROCKFORD, ILLINOIS

MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

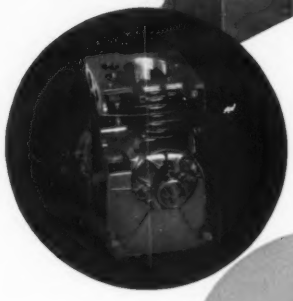


CONTROL PARTS INVENTORY

with guaranteed **single-size** mating parts

Barnesdril honing control eliminates size differences (tenths) between bores;

guarantees one-size finishing



BarnesdriL honing machines with controlled sizing automatically establish positive limits on cylinder bores, connecting rods, gears and other mating parts. Because single size is guaranteed bore-to-bore through Plugmatic Sizing, production of mating parts is simplified and inventory is held to a minimum.

The inherent capacity of BarnesdriL Honing to hold bore tolerances precisely, and guarantee single size bore-to-bore, reduces both operating and inventory costs. Ask for production estimates on your bore finishing operations. A BarnesdriL engineer will be glad to call.

New bulletin no. 550

completely describes controlled size, finish and accuracy with BarnesdriL Honing. Write for a copy.

BARNES DRILL CO.

830 CHESTNUT STREET • ROCKFORD, ILLINOIS
DETROIT OFFICE: 13121 Puritan Avenue

FOR PRODUCTION MACHINE TOOLS IT'S **ROCKFORD, ILLINOIS, U.S.A.**

ROCKFORD MACHINE TOOL CO. 2500 KISHWAUKEE STREET ROCKFORD, ILLINOIS

SPEED and VERSATILITY
of
Rockford Hy-Draulic Shaper-Planers
provide
"Off-The-Shelf Delivery"
for
DREIS & KRUMP
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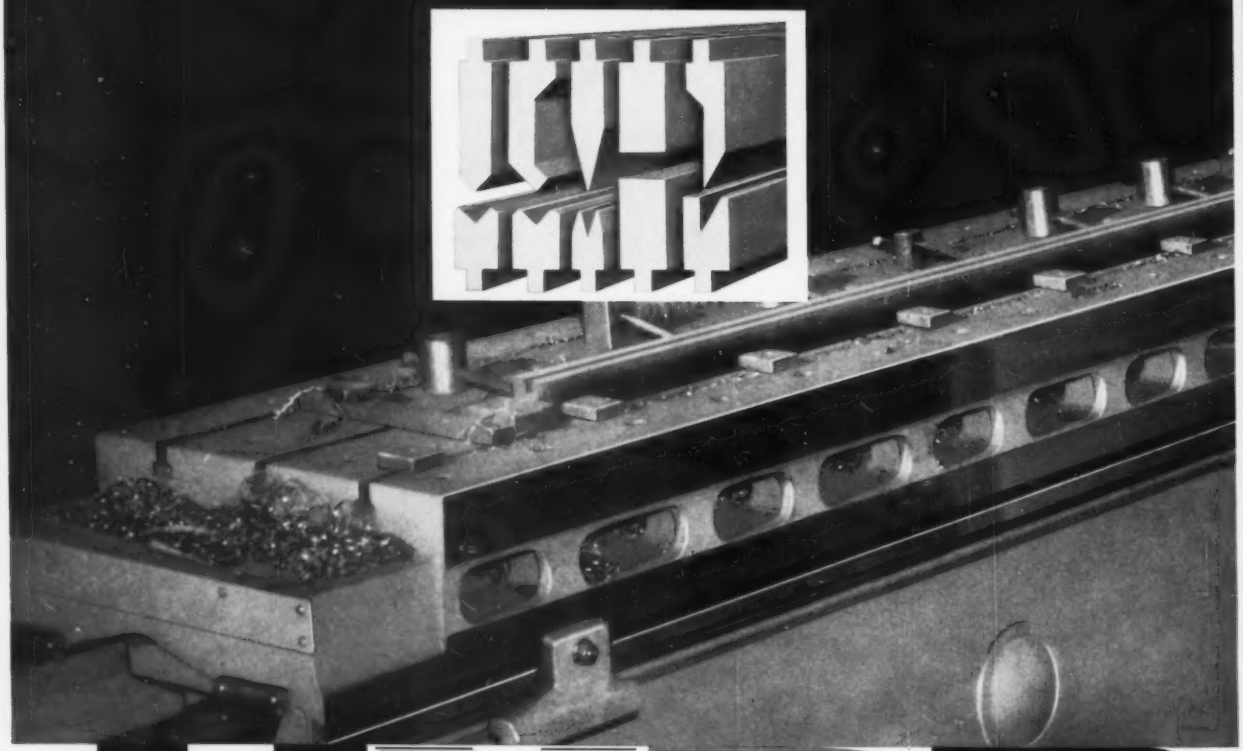
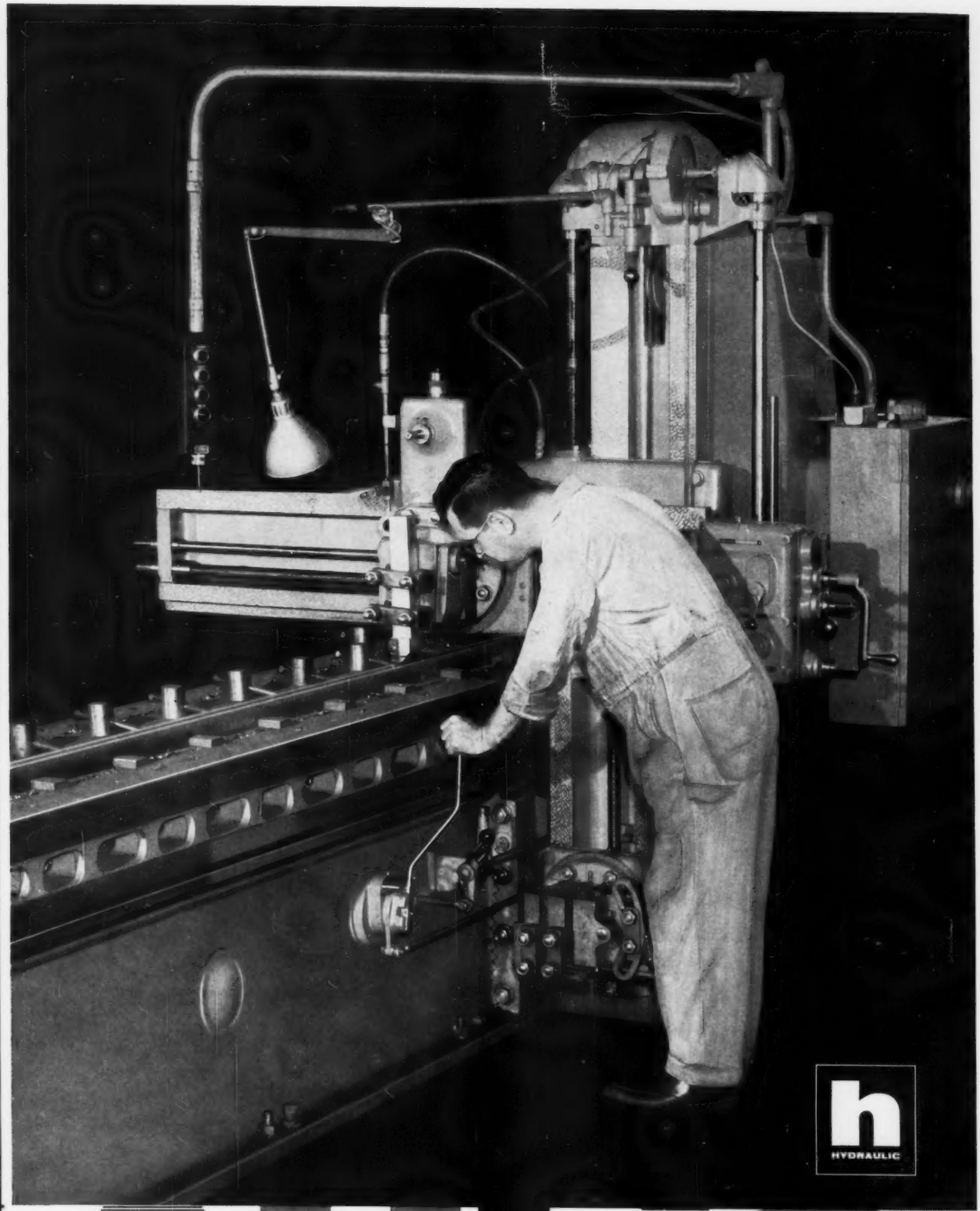


HY-DR

Machinery, January, 1939

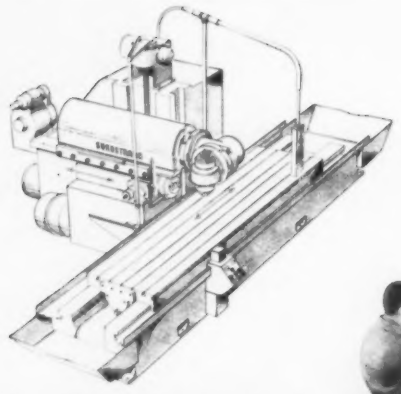
CENTER OF MACHINE-TOOL EXCELLENCE ROCKFORD, ILLINOIS, U.S.A.



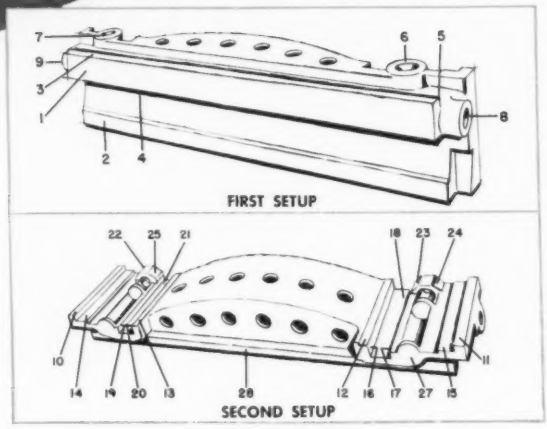
AULIC

FOR PRODUCTION MACHINE TOOLS IT'S **ROCKFORD, ILLINOIS, U.S.A.**

SUNDSTRAND 50-hp machines 28



Arrowheads on sketch show movements and adjustments of machine elements that make this universal bed-type Rigidmil with All Angle head exceptionally versatile



● Do you need a machine that has rigidity and power for a wide range of cuts and adds versatility to reduce parts handling and the need for expensive, special fixturing? If you do, then the universal bed-type Rigidmil with All Angle head was practically designed for you. The 28 surfaces machined in the two setups shown are typical of the range of operations readily handled on this machine.

Both the horizontal spindle head and the All Angle ram type head have the horsepower needed to handle sizable cuts. Horizontal spindle provides 50-hp maximum, and the All Angle head 20-hp maximum.

Up to 216 inches table feed stroke . . . ⅜ to 220 inches per minute longitudinal table feed . . . ⅜ to 100 ipm transverse column feed . . . ⅜ to 50 ipm head feed . . . pushbutton control of machine speeds and movements . . . these are some of the features that indicate the machine's ability to handle a broad range of work. Slab milling can also be performed using the main spindle and mounting an arbor support on the dovetail ways provided in the machine's design.

AUTOMATIC LATHES | SIMPLEX RIGIDMILS | DUPLEX RIGIDMILS | TRIPLEX RIGIDMILS | SPECIAL MACHINES

SUNDSTRAND "Engineered Production" Service"

CENTER OF MACHINE-TOOL EXCELLENCE **ROCKFORD, ILLINOIS, U.S.A.**

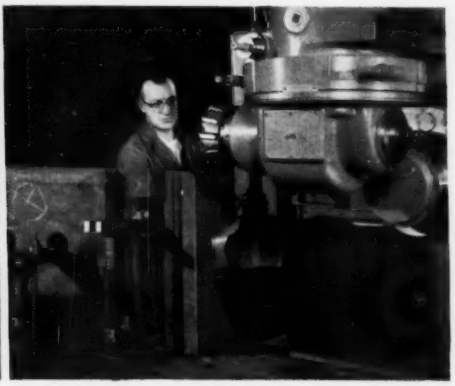
RIGIDMIL
surfaces in just 2 setups

Positioning cutter instead of work reduces setup time

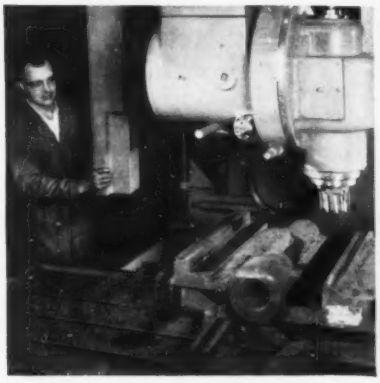
HERE'S HOW TO CUT SETUP TIME . . . Sizable cuts are taken with both the All Angle head and the main horizontal spindle so that production rate stays high despite the unparalleled flexibility. Carbide cutters are used to full advantage on both spindles as shown in typical operations below. Accuracy invariably exceeds that possible on conventional machines because of reduced parts handling. Surfaces 1 to 9 machined in first setup. Surfaces 10 to 28 machined in second setup.

HORIZONTAL SPINDLE and longitudinal table feed are used for face milling first surfaces of large casting.

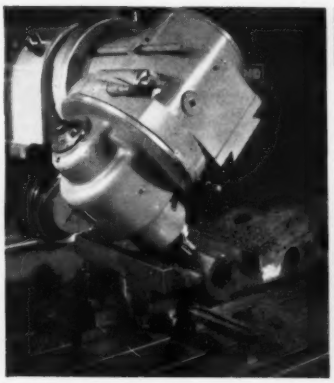
MACHINING ON TOP of the work is illustrated in this example using the All Angle head and longitudinal table feed.



ANOTHER EXAMPLE of the ease with which it is possible to move the cutter instead of workpiece is on this step using All Angle head and vertical feed.



ANOTHER POSSIBLE combination of machine movements is shown here where All Angle head in vertical position is coupled with transverse feed.



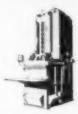
ALL ANGLE HEAD is used to mill clearance cuts at an angle using transverse feed. All power feeds are infinitely variable.

HORIZONTAL SPINDLE returns to action in combination with longitudinal table feed. Power operated drawrod (extra) for horizontal spindle makes cutter changing easier.

ADDITIONAL DATA describing the universal bed-type Rigidmil with All Angle head is available in Bulletin 699. Write for your copy today!

SUNDSTRAND MACHINE TOOL CO.

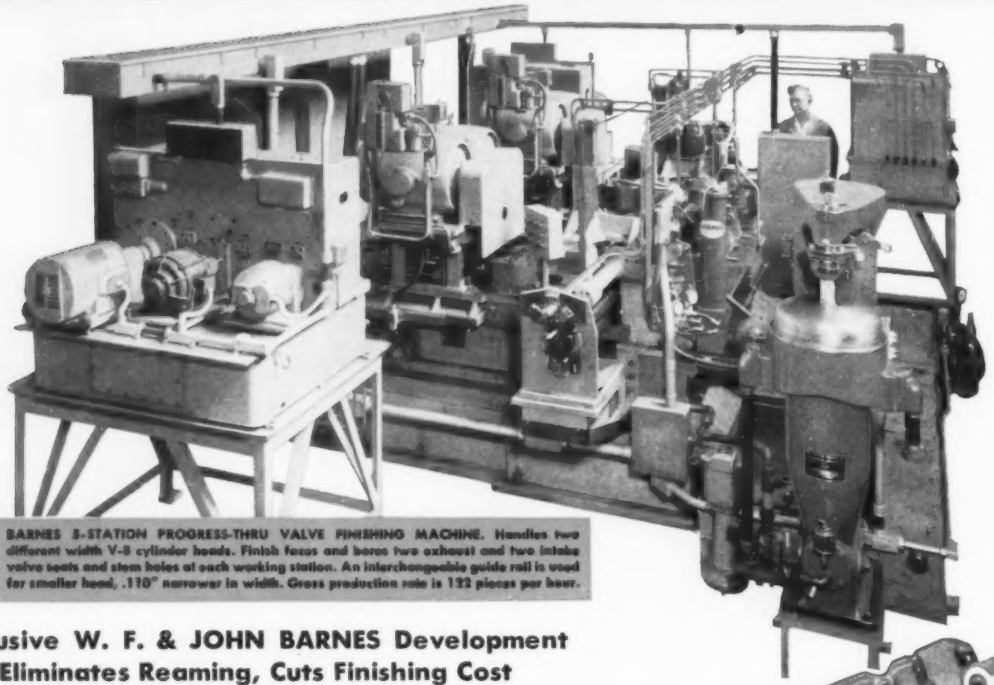
2530 ELEVENTH ST., ROCKFORD, ILLINOIS

BROACHING TOOLS	THREE WAY	SINGLE RAM	HORIZONTAL	DUPLEX RAM	PRESSES
					

SUNDSTRAND "Engineered Production Service"

CITY OF MACHINE-TOOL SPECIALISTS **ROCKFORD, ILLINOIS, U.S.A.**

FINISH-MACHINES VALVE SEAT and STEM HOLES in Single Pass



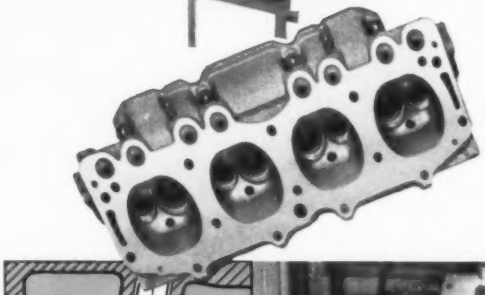
BARNES 8-STATION PROGRESS-THRU VALVE FINISHING MACHINE. Handles two different width V-8 cylinder heads. Finish faces and bores two exhaust and two intake valve seats and stem holes at each working station. An interchangeable guide rail is used for smaller head, .110" narrower in width. Gross production rate is 122 pieces per hour.

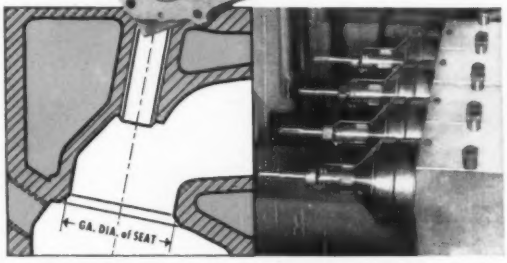
Exclusive W. F. & JOHN BARNES Development Eliminates Reaming, Cuts Finishing Cost

More and more manufacturers of internal combustion engines are today profitably using W. F. and John Barnes machines to cut costs in processing valve seats and stem holes. The accuracy of this new, exclusive tooling method reduces machining costs by eliminating the need for reaming or other final finishing operations. Guide holes are finish-bored and valve seats finish-faced simultaneously in a single pass. Concentricity of the valve stem hole and face is held within .0005" total indicator reading.

Basic Method Can Be Easily Applied To Either Small or Large Jobs

The efficiency of this new machining method can now be economically applied to all types of valve jobs — small as well as large cylinder heads or blocks. Either fully automatic or semi-automatic machines can be provided to suit your production needs. As illustrated, single machines can also be designed to efficiently handle more than one size workpiece which effects additional savings in floor space and equipment costs.





CONCENTRICITY .0005" T.I.R.

Fine finish to precision tolerances eliminates reaming operations. Concentricity of guide hole and gauge diameter of seat is held to .0005" T.I.R.

DUAL-TYPE PRECISION SPINDLES

Dual-type precision spindles equipped with facing and gun boring tools. A second 4-spindle head on machine above completes valve operations on V-8 cylinder heads.

Builders of Better Machines Since 1872

W. F. & JOHN BARNES

ASK FOR AN ANALYSIS OF YOUR MACHINING METHODS — Ask a Barnes engineer to work with you when planning new or improved machining methods. His experience with, and knowledge of, proven cost-cutting methods can help you save time and money. *Write for New Catalog* illustrating how Barnes 6-point machine building service saves you time, and eliminates divided responsibility.

W. F. & JOHN BARNES COMPANY

402 SOUTH WATER STREET • ROCKFORD, ILLINOIS

Multiple Spindle Drilling • Boring • Tapping Machines • Automatic Progress Thru Transfer-Type Machines

CENTER OF MACHINE-TOOL EXCELLENCE **ROCKFORD, ILLINOIS, U.S.A.**

MATTISON
HIGH-POWERED PRECISION
GRINDING METHODS

New Quick-Tilt© spindle can increase your grinder production 50%

Converts from roughing to finishing in seconds

Until now, users of vertical-spindle surface grinders have had to compromise either accuracy or production because of the difficulty in tilting the wheel spindle. In fact, to combine high stock removal with fine finish and flatness meant paying for two operations instead of one.

Now it is possible to tilt the spindle by just turning a selector switch. You have power-tilting to eliminate wheel drag when roughing, yet in a matter of seconds the grinding wheel can be reset to the flat position for finish grinding.

Simple, isn't it? You might even ask: "Why didn't you think of this ten years ago?" Actually, the real significance of this feature lies in the new thinking about surface grinding as a stock removal operation. Ten years ago grinding was considered a finishing process. Therefore, it was not until we had proved the direct and indirect cost savings made possible by grinding from the rough that the need for power-tilting spindles became imperative.

Production tests in our Methods Laboratory show that the average grinding operation can be at least 50% more efficient—that's comparing one machine with the wheel set flat against one on which the cycle is divided between roughing and finishing. But, the profit significance of power-tilting shows up more dramatically when *grinding* through outer scale and burned edges instead of milling or planing.

How to increase stock removal

With a tilted spindle your motor horsepower is applied over a smaller wheel area for greater grain penetration. This produces a bigger chip. You can use harder wheels and still get breakdown.

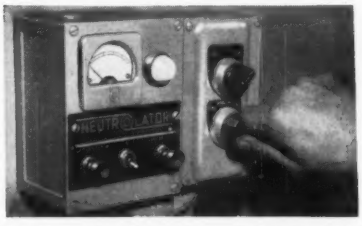


Fig. 1—Turning the selector switch automatically tilts the spindle .010 in. toward the leading edge, or back to dead flat.

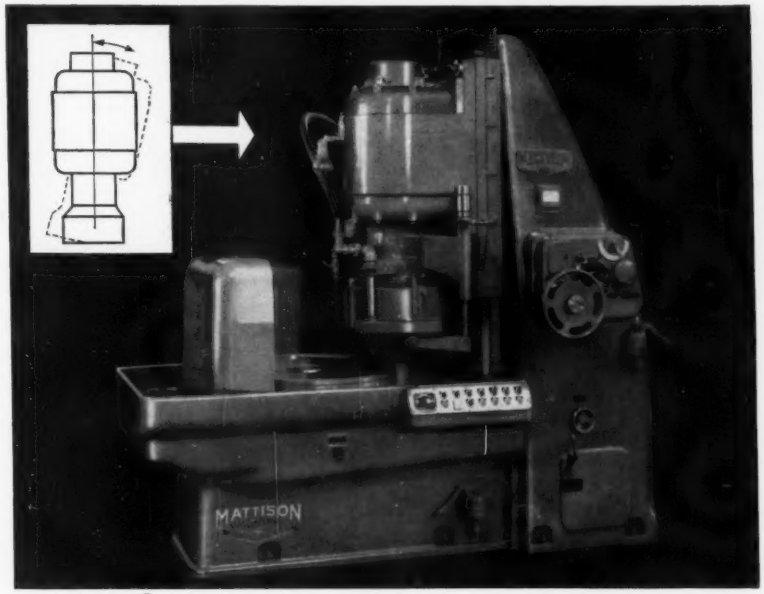


Fig. 2—Quick-Tilt© spindles solidify all the accuracy and stock removal features built into Mattison No. 24 and 36 rotaries. These machines are being built with spindle motors up to 60 hp to provide optimum cutting speeds on stock-removal operations.

With modern casting and forging techniques, there is no reason why stock allowances should not be specified for rough grinding of flat surfaces. This means a saving of approximately 50% of the stock allowance normally required for tool or cutter finishing. If close tolerances or finish are requirements, think of the dual advantages by grinding.

Hard spots, scale, and burned edges are no problem. We can show you examples of savings on parts such as bolster plates, forging dies, pump castings, and forged steel chain links.

Increases accuracy of small parts

With the practical elimination of curvature during the finish grind, more small parts can be ground per table load and setups can be speeded because the work need not be centered in relation to the wheel "ellipse." You use the same, easily adjusted clearance for every job. Leave enough stock for finishing and it is possible to grind over the full diameter of the wheel and still hold precision tolerances on all parts whether they're located at the outer edge or under the low point.

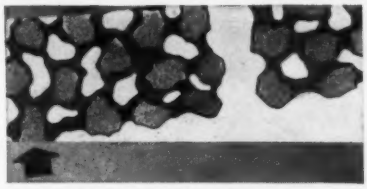


Fig. 3—Tilting the spindle reduces contact area between segments and work, permits use of higher horsepower and harder wheels. Slight bevel at leading edge reduces contact area for finishing.

See a demonstration

We are producing perfect diamond finishes on parts having large, uninterrupted surfaces. We can show you production savings, wheel life, and accuracy on test jobs or your own. Your Mattison dealer will make all the arrangements.

MATTISON MACHINE WORKS
Rockford, Illinois Phone 2-5521

Want more information? Send for new catalog describing Quick-Tilt spindle and other exclusive features of Mattison's Nos. 24 and 36 Vertical Rotarys.

MATTISON MACHINE WORKS ROCKFORD ILL. U.S.A.

HIGH-POWERED PRECISION SURFACE GRINDERS

CITY OF MACHINE-TOOL SPECIALISTS **ROCKFORD, ILLINOIS, U.S.A.**

The ACKNOWLEDGED AUTHORITY of the METALWORKING INDUSTRIES

For forty years . . . through fourteen editions . . . with over a million copies sold, MACHINERY'S HANDBOOK has been the indispensable reference book for designers and builders of mechanical products. Now the 15th Edition, with over 400 pages revised and brought up to date, gives you the latest and most authoritative information on present-day designing, manufacturing and metalworking practices.

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A modern handbook is a necessity for every man who holds or hopes to hold a responsible job in the mechanical industries. Shop men, as well as engineers and designers, find MACHINERY'S HANDBOOK invaluable. It contains the kind of information that is needed wherever machines, tools, and mechanical devices are designed or constructed.

MACHINERY'S HANDBOOK contains 1911 pages of mathematical and mechanical tables, rules, formulas and general data (see complete table of contents on page 3). Its "math" and other tables never subject to change are accurate to the last decimal point, because Handbook users all over the world have been checking them for 40 years.

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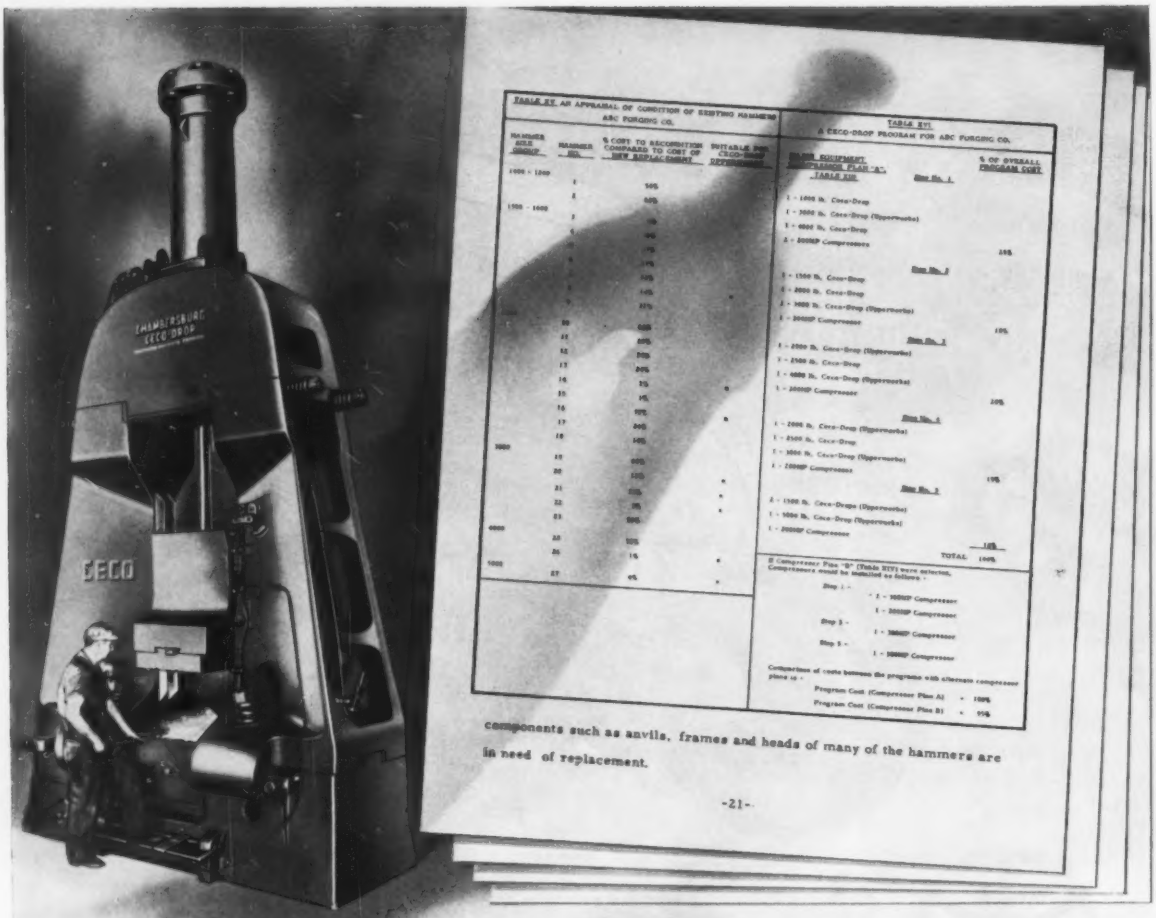
THE INDUSTRIAL PRESS
93 Worth Street, New York 13, N. Y.

Ask for our Bulletin RH-132-01 which describes the new MIKRON 15-Second Spacing Accuracy Machine.

RUSSELL, HOLBROOK & HENDERSON, INC.

292 Madison Avenue, New York 17, N. Y.

For more data, circle this page number on inquiry card



components such as anvils, frames and heads of many of the hammers are in need of replacement.

-21-

A Realistic Approach to Forge Shop Modernization

During the past few years, mounting competition has caused forge shop managers to seek ways to further increase production and reduce costs. A number have scrapped their old board hammers replacing them with Ceco-Drops, the modern piston-lift gravity-drop hammer. These shops have thus placed themselves in a position to get more business—and they are getting it! ● A wealth of helpful information is available in Chambersburg's new 28 page forge shop modernization bulletin. Based on studies made in prominent forge shops, this publication assists you to formulate your own step-by-step modernization program. Write for a copy today.

CHAMBERSBURG ENGINEERING COMPANY · · CHAMBERSBURG, PA.

"Far Superior to its Competition"...

. . . states Mr. Creighton Blanchard, toolroom superintendent at New Hampshire Ball Bearings, Inc., Peterborough, New Hampshire

THE NEW, IMPROVED THOMPSON TYPE D HAND FEED

SURFACE GRINDER

is winning enthusiastic approval wherever precision work is required

Here's what Mr. Blanchard has to say about the new Type D machine:

"We have three grinders in our toolroom—a Thompson and two competing machines. In our general toolroom grinding, especially on carbide and hard metals, we find the Thompson Type D so superior that we have recently purchased another Thompson just like it. All our precision work goes on the Thompson."

Compare these features

- Steel roller anti-friction slides eliminate ball creep and increase rigidity.
- 14" standard vertical capacity under 7" wheel at no extra cost with no loss in vertical capacity when using wet attachment.
- Solid support through entire length of bearing quill assures extra fine finish.
- 5 inch table movement per turn of handwheel improves quality of finish and speeds up operations.
- No backlash, anti-friction ball nuts and screws on cross feed prevent wheel from creeping away from work in shoulder grinding.
- Swing-out stop for table dog contact permits quick movement to wheel dresser.
- Immediate delivery available.

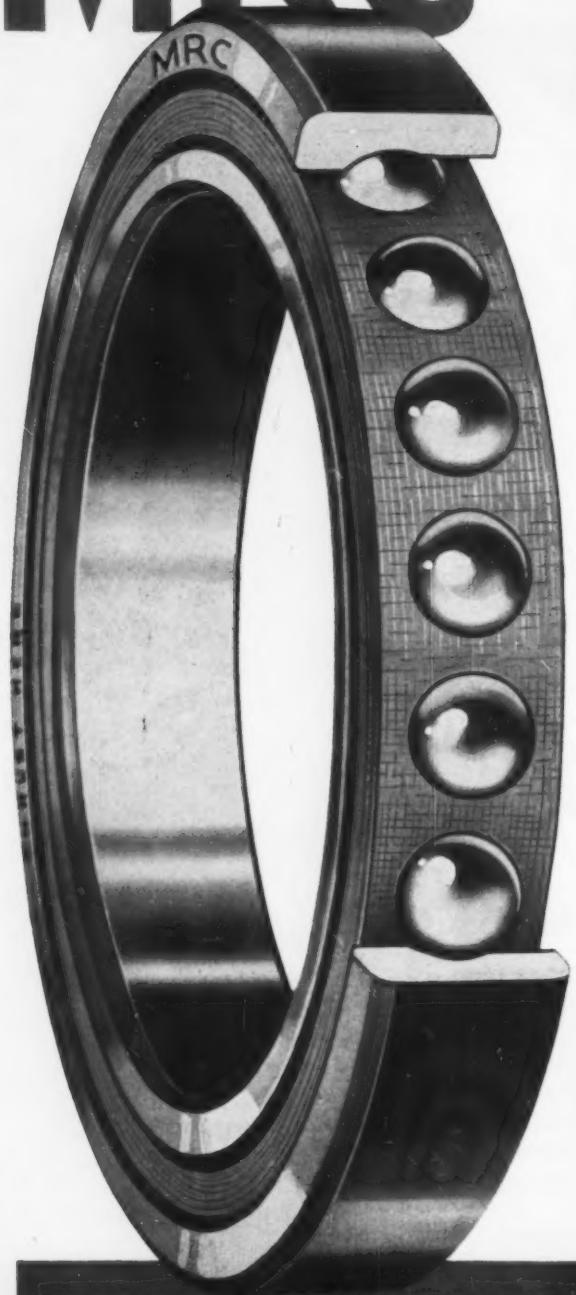
Send for descriptive literature on the new Thompson Type D Grinder.

THE THOMPSON GRINDER CO.
SPRINGFIELD, OHIO

"Keep Thompson in mind for that daily grind"

Thompson SURFACE GRINDERS

MRC EXTRA-LARGE *Super-Precision* bearings



for lathes, grinding spindles, headstocks, hobbing machines, radial drills, jig borers and other machine tools.

M-R-C EXTRA-LARGE BEARINGS, backed by over half-a-century of engineering and manufacturing experience, are designed to provide maximum accuracy and capacity.

Write OUR Engineering Department regarding YOUR bearing problems

MARLIN-ROCKWELL CORPORATION
Executive Offices: **Jamestown, N.Y.**

MRC BALL AND ROLLER *bearings*

REDUCE DRILLING COSTS...

INCREASE HOLE ACCURACIES

RIGHT NOW!

. . . with your own standard twist drills sharpened to SPIRAL POINT — Cincinnati's new drill point geometry.

Drill PRECISION holes with Spiral Point **—all the way up to 1" diameter.**

Get accurate hole size . . . straighter, rounder, cleaner holes . . . and you eliminate secondary operations. Maintain hole-positioning accuracy without costly guide bushings or pre-centering. Get more holes per grind.

CONVERT

the twist drills in your plant to *precision Spiral Points* with the new Cincinnati SPIROPOINT® DRILL SHARPENER. It automatically applies this cost-saving geometry in a matter of seconds.

IMMEDIATE DELIVERY
on sizes to 1"

Improved Machining Through Research

CINCINNATI LATHE AND TOOL CO.

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"TRAY-TOP" Lathes / "CINCINNATI" Drilling Machines / "SPIROPOINT" Drill Sharpeners

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ALLEN HEX-SOCKET SCREWS HEAD

HERE'S ALLEN TODAY!

These precision products have made ALLEN the number 1 name in the socket screw field!

Leader Point Cap Screw | Button Head Cap Screw | Flat Head Cap Screw

Allenut | Allenpoint Set Screw | "Tru-Round" Pipe Plug

Allen Shoulder Screw | Allen Hex Key | "Tru-Ground" Dowel Pin

If hex-socket screws have any place in your life at all, our new plant at Bloomfield, Connecticut, has unlimited advantages for you.—If you're an engineer or designer, for example, the modern facilities of this new plant make available to you greatly increased engineering and metallurgical services in the development of dependable fastening for products you're designing—and higher standards of precision than ever before. If you're a manufacturer, this new plant is bound to be a rich source for new ideas in fastening, and new products that will make your own products better. If you are a distributor, this new plant means prompter shipments—and both new products for your customers and improvements in existing ones, all coming along rapidly now that we have the room we need and new equipment.

Write today for our new picture-booklet that takes you on a "guided tour" of this modern new plant.

ALLEN MANUFACTURING COMPANY

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Plant at Bloomfield, Connecticut • Warehouses at Chicago and Los Angeles

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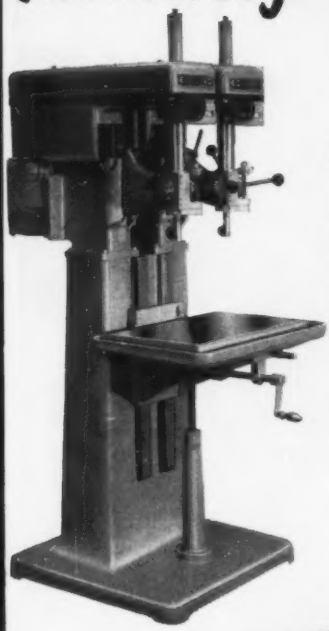
EDLUND

"F" SERIES

Infinitely Variable Speeds



Edlund Model 1F

Sensitive machine for small parts and components.

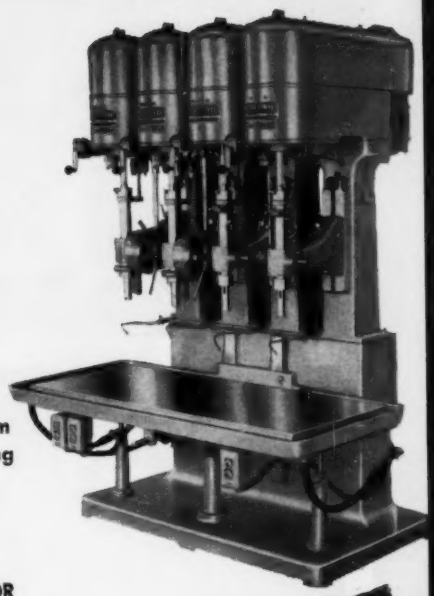
Infinite selection of speeds to 10,000 rpm

7" & 10" Overhang

⅜" Capacity

Pedestal and Bench models

Write for Bulletin 160



Edlund Model 2F

A top production machine for medium to heavy drilling and tapping.

Infinite selection of speeds to 3,600 rpm
8"–12"–15" Overhang
1¼" Capacity

Pedestal and Round Column types

Write for Bulletin 140R

America's Most Versatile Drilling Machines

Edlund Model 4F

A work-horse production machine for heavy duty drilling and tapping operations.

1¾" capacity with infinite selection of speeds to 2200 rpm
12" Overhang

Pedestal or Round Column Types

Write for Bulletin 170 R

NEW!

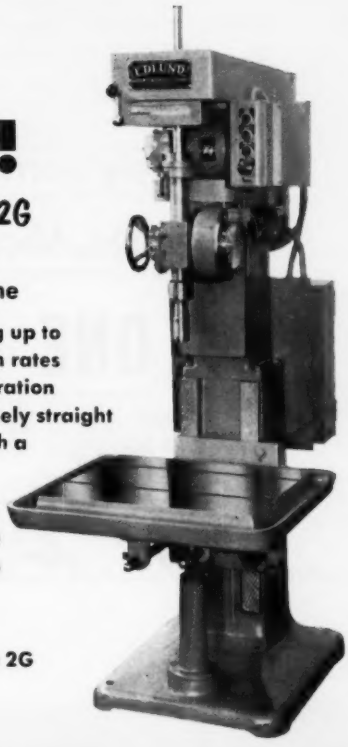
Edlund Model 2G

Vertical Gun Drilling Machine

Deep hole drilling up to 7½" at production rates in one single operation producing extremely straight smooth holes with a finish from 4-8 micro-inches.

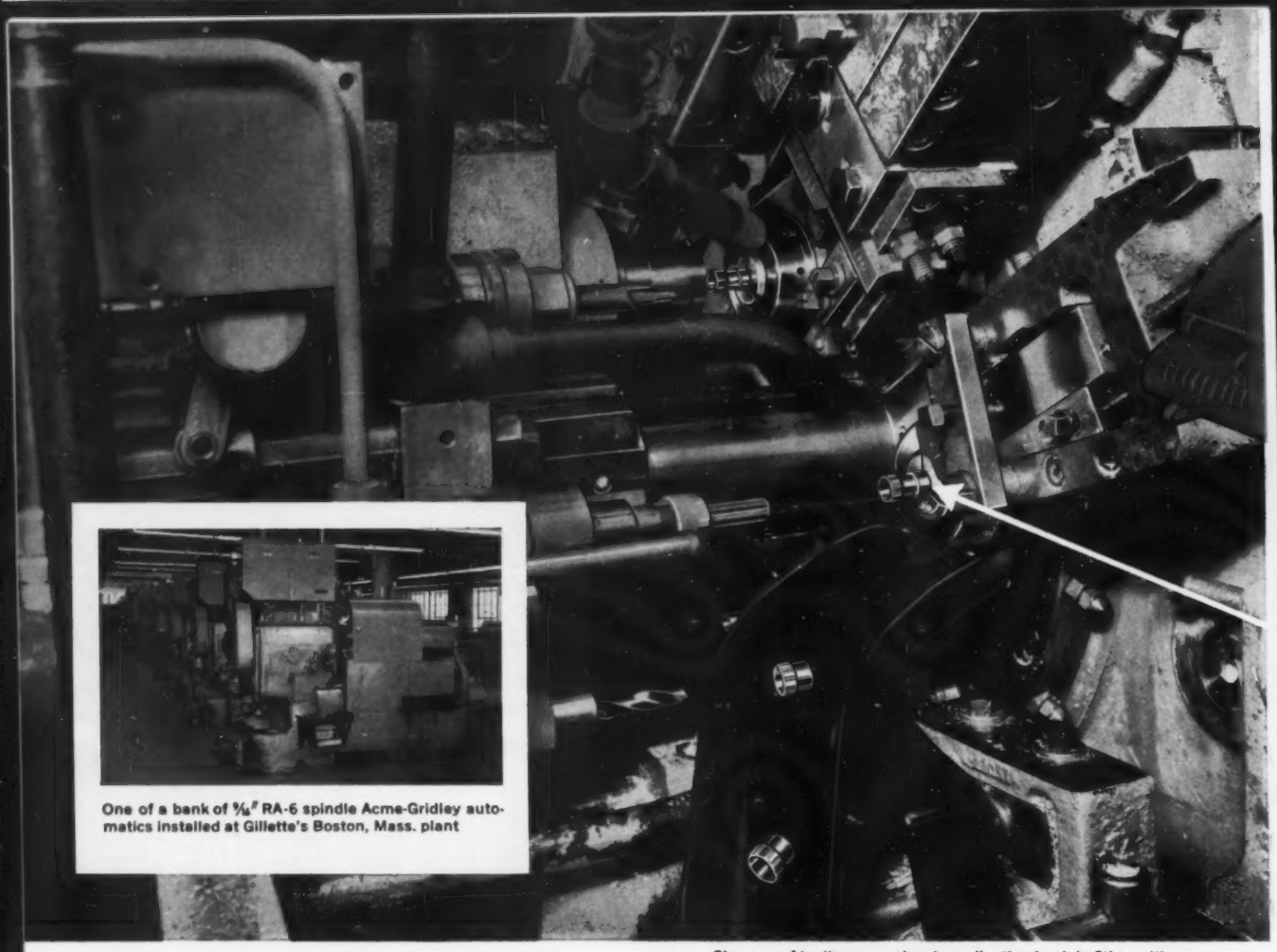
⅝" Capacity with spindle speeds to 8000 RPM
12" Overhang

Write for Bulletin 2G



EDLUND REPRESENTATIVES IN MAJOR CITIES

EDLUND MACHINERY CO. Cortland, New York Division of Harsco Corporation



One of a bank of 5/16" RA-6 spindle Acme-Gridley automatics installed at Gillette's Boston, Mass. plant

Close up of tooling zone showing adjusting knob in 5th position

Precisely Formed, Marked, Knurled,

Broached, Micro-finished, Reamed and Tapped . . .

ON ONE ACME-GRIDLEY AUTOMATIC

in *4½ Seconds!*

The adjusting knob on this new adjustable razor is but one of its several precision components made by The Gillette Safety Razor Company on 7/16" Acme-Gridley six spindle bar automatics. The requirements were extremely exacting, *with as many operations as possible performed in the primary setup!*

For example: nine positions are stenciled on a turned portion of the O.D. with interrupted knurling held in exact peripheral location to the marking. In addition, close tolerance hole sizes are involved and *all* external burrs completely removed. All tools had to be synchronized to produce the exacting number-knurl relationship on the periphery.

Working in close cooperation with Gillette engineers, National Acme specialists took full advantage of the wide-open tooling zone, independently operated tool slides and the extreme accuracy and flexibility of direct camming . . . to perform an ingenious job of tooling. Many operations normally considered "secondary" were accomplished in the primary setup. Costly rehandling and "second machine investments" were reduced.

Write or ask one of our representatives for the complete story on the industry's most modern approach to *your* cost reduction problem.

Pioneer in Circumferential Automation

National Acme

The National Acme Company
179 E. 131st Street
Cleveland 8, Ohio

Sales Offices: Newark 2, N.J.; Chicago 6, Ill.; Detroit 27, Mich.

Immediately Available...

When and Where you need them

VICKERS®
Hydraulics

- **WAREHOUSE STOCKS***
- **REPAIR FACILITIES**
- **FIELD SERVICE**

Overnight Service Anywhere

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  1029 So. Kildare
  NEvada 8-0101
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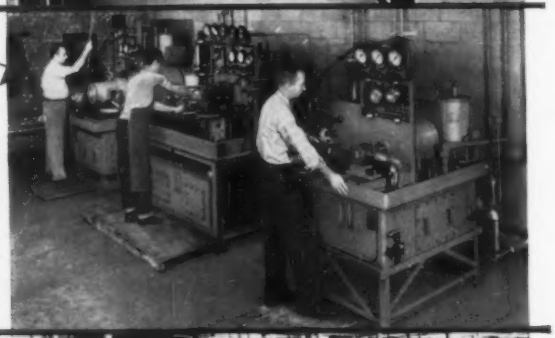
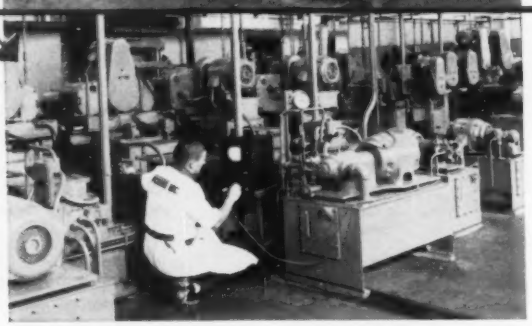
  (El Segundo, California)
  ORegon 8-2503
- **Seattle**
  623 Eighth Ave., South
  MUtual 2-6950
- **Springfield (N. J.)**
  51 Springfield Ave.
  (Newark Proximity)
  DRexel 6-3500
- **Toronto**
  Vickers-Sperry of Canada, Ltd.
  92 Advance Road
  BElmont 2-1191





- **Stock Units and Parts***
- **Repair or exchange of Units**—promptly—tested to factory specifications
- **Testing facilities**
- **Field service**—other Field Service Headquarters locations listed below (underlined)

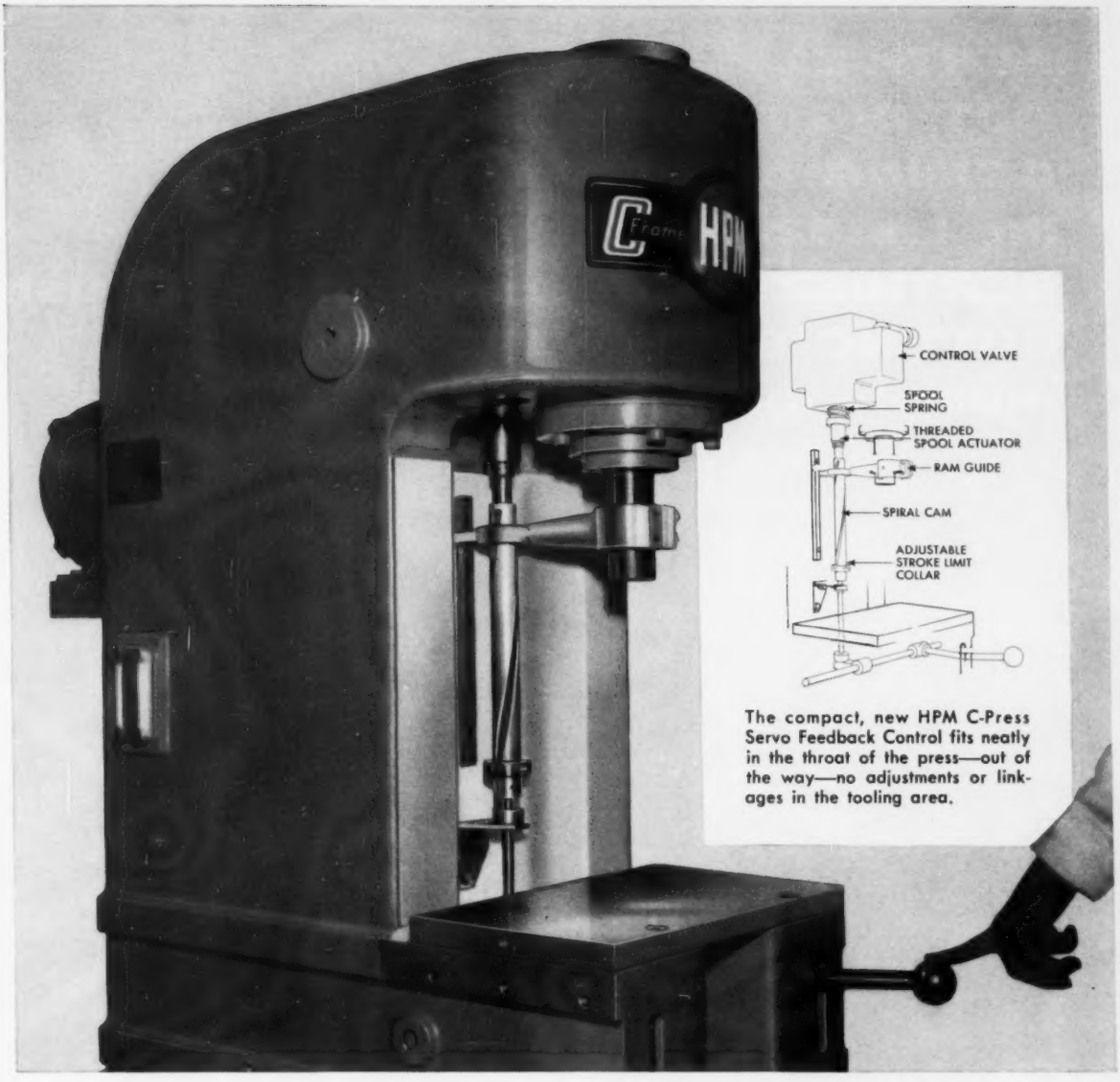
*Applies to standard Industrial line products and selective Mobile products—Aircraft products are not included.

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
Machinery Hydraulics Division
ADMINISTRATIVE and ENGINEERING CENTER
Department 1403 • Detroit 32, Michigan

Application Engineering Offices: ATLANTA • CHICAGO* • CINCINNATI • CLEVELAND • DETROIT* • GRAND RAPIDS • HOUSTON • INDIANAPOLIS • LOS ANGELES AREA (El Segundo)* • MILWAUKEE • NEW YORK AREA (Springfield, N.J.)* • PHILADELPHIA AREA (Media) • PITTSBURGH AREA (Mt. Lebanon) • PORTLAND, ORE. • ROCHESTER • ROCKFORD • SAN FRANCISCO AREA (Berkeley) • SEATTLE* • ST. LOUIS • WORCESTER • Factories also in: Australia, England, Japan and Germany • In Canada: Vickers-Sperry of Canada, Ltd., Toronto,* Montreal and Vancouver
Field Service Headquarters Underlined. Whse. Stock & Repair Branches*.

8154A

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921



The compact, new HPM C-Press Servo Feedback Control fits neatly in the throat of the press—out of the way—no adjustments or linkages in the tooling area.

SERVO-FEEDBACK . . . NEW DEMAND-RESPONSE CONTROL FOR MANUAL C-PRESS OPERATIONS

INSTANT RESPONSE to the demand of the hand lever is featured in new Servo Controlled H-P-M C-Presses. The new system offers many advantages. Ram speed is directly proportionate to rate of lever control movement through a direct metering valve. The application of *force on work* is in direct response to movement of the control lever. The *position* of the ram is accurately controlled by the lever until the work is contacted. The pressure control then takes over and further lever movement increases pressure on the work. Releasing the lever will immediately decrease the pressure and then return the press ram to its adjustable up position. The downward travel of the press ram may be limited by means of the adjustable lower stop-collar.

This direct relationship between demand and response is accomplished by a unique, compact, spiral cam principle that meters oil to the cylinder in direct response to the action of the hand lever. For *straightening* operations it permits the operator to apply force on work to gauge readings — accurately and effectively. For *compacting* it permits rapid approach, slow pressing or bumping, repeat strokes if needed. *For lab or experimental work* where applied force must be carefully analyzed, the HPM C-Press offers many advantages.

Many production jobs may be improved through the use of this unique and versatile manual press line. Available in 5, 10 and 15 ton models. Get the complete details by asking for Bulletin H58CPM. Plan for more profits by planning with H-P-Ms.

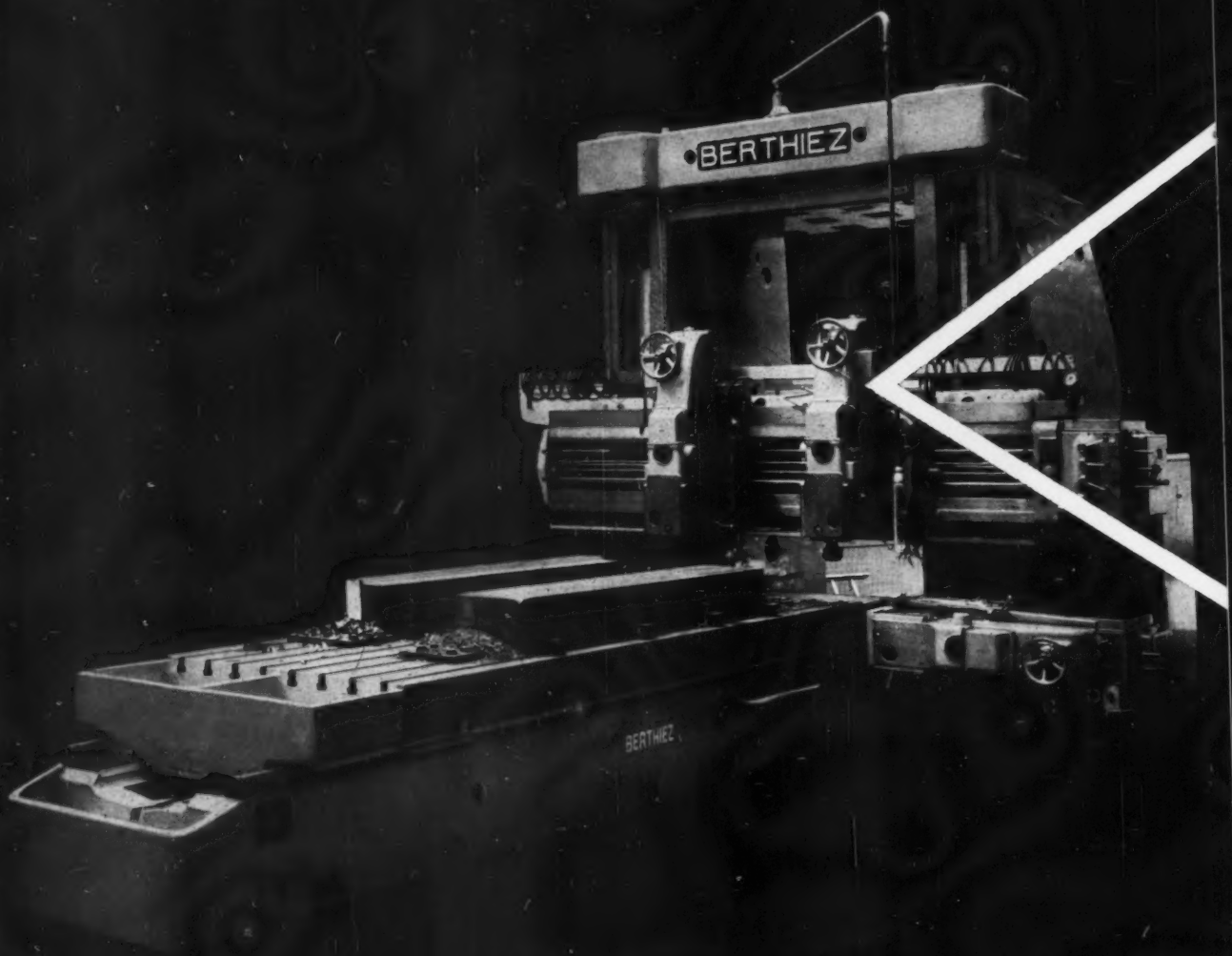
HPM

THE HYDRAULIC PRESS MFG. COMPANY

A Division of Koehring Company, Mount Gilead, Ohio, U.S.A.

H901

BERTHIEZ has been
CUTTING BOTH WAYS,
COMING AND GOING for
the last 12 years
BERTHIEZ has been rough and finish
CUTTING BOTH WAYS with
multiple tools for the last 10 years



BERTHIEZ has supplied over 100 large Single and Double Upright Planers CUTTING BOTH WAYS, COMING AND GOING since 1946 which have been working year in and year out ON DOUBLE WAY CUTTING

BERTHIEZ

HEAD OFFICE, 5, RUE MONTALIVET, PARIS (FRANCE)

From ROUGH BLANK to FINISHED GEAR *In 5 Seconds*

How? a New Red Ring Broaching Process

ACCURACY:

Pin size to .0009″

Lead to .0008″

Involute error .0003″

Composite error less than .001″

FLOOR–FLOOR: 15 Seconds

CHARACTERISTICS: 87 teeth, 24 pitch, 22° helix, 4″ O.D., ¾″ face—cast iron.

TOOL LIFE: After broaching 26,000 parts, this broach was resharpened by the removal of only .010″ of metal. In other cases, production would be governed by operating conditions.

REPLACES SIX HOBBING MACHINES

8168

The above are actual production figures showing the possibilities of this amazingly effective broaching process.

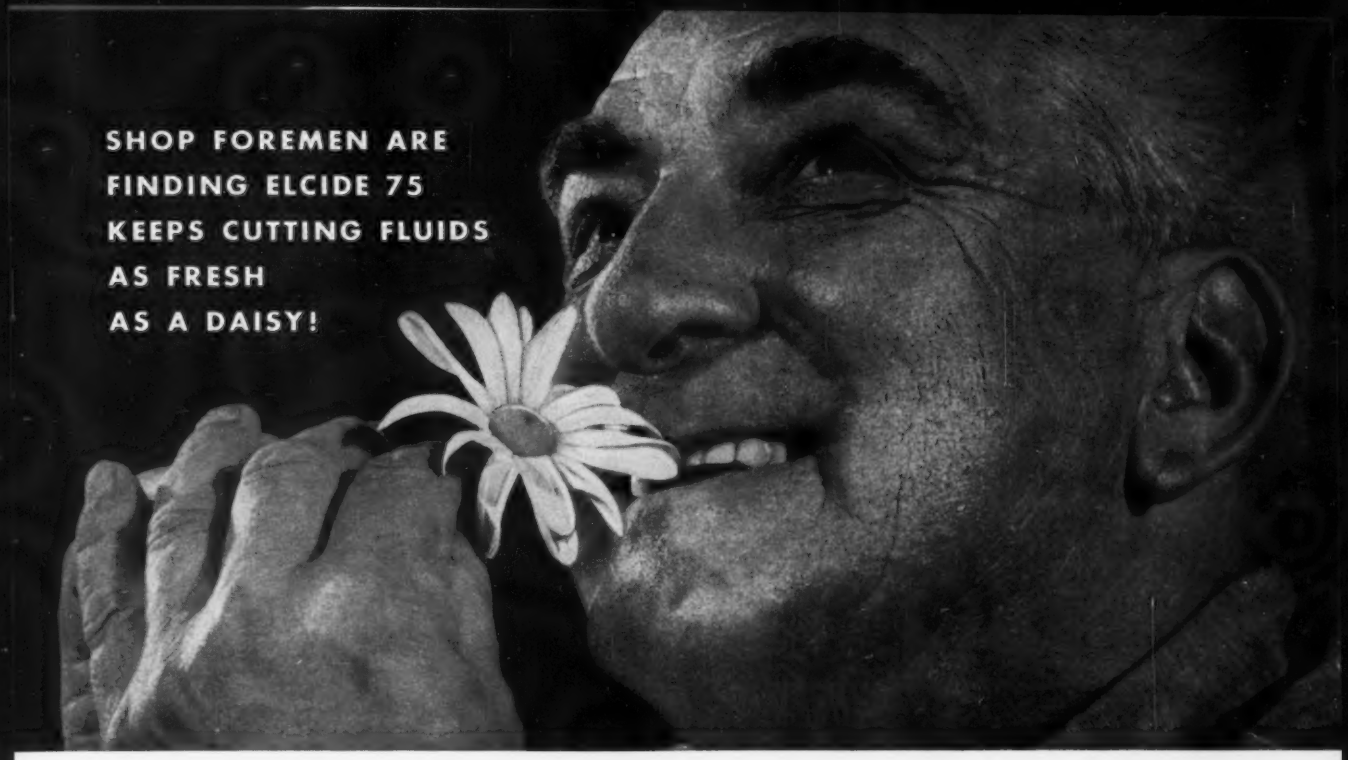
The consistent precision and speed attained do not depend on the operator. They are engineered into the tooling.

Investigate the savings of this process as applied to your operations. Get the whole story from a Red Ring engineer.

NATIONAL BROACH & MACHINE CO.

5600 ST. JEAN • DETROIT 13, MICHIGAN

WORLD'S LARGEST PRODUCER OF GEAR SHAVING EQUIPMENT



You have less down time when you treat emulsions with new ELCIDE 75™

One ounce of Elcide 75 per each four gallons of standard duty soluble oil emulsion controls the harmful bacteria that shorten emulsion life. In one shop test, emulsions treated with Elcide 75 lasted 5½ times longer than untreated emulsions!

Longer emulsion life means less down time and more efficient use of labor. The time lost on recharging emulsions is greatly reduced, and so is the size and expense of disposal problems.

Extended shutdowns are less of a problem when emulsions are treated with Elcide 75. Since Elcide 75 can be safely stored for long periods, some plants have found a reserve supply is extremely useful as protection for emulsions during extended shutdowns such as vacations and inventories.

Plant efficiency is increased several ways. Elcide 75 controls bacteria that may cause staining and corrosion. It is safe and nontoxic to employees, and its antibacterial action eliminates objectionable odors.

Elcide 75 effectively controls bacteria that cause odor, staining, corrosion, and emulsion breakdown because it is a *combination* of two powerful antibacterial agents. It includes a powerful new compound related to one of the safest and most effective bacterial inhibitors used in the exacting field of medical surgery. Elcide 75 covers a much wider range of bacteria than the single inhibitors commonly used in emulsions today.

PRODUCT SPECIFICATIONS ELCIDE 75

Active Ingredients—Sodium Ethylmercuri Thiosalicylate (Thimerosal) and Sodium *o*-phenylphenate.

Package	Price per Gal.
1-gallon (4 per case), polyethylene	$8.50
5-gallon polyethylene	$8.00
55-gallon stainless steel	$6.50

Sold only through selected distributors.

Lower your operating costs. If you use standard duty soluble oil emulsions, Elcide 75 can save you money. Production goes up as costs go down. The reduction in total soluble oil purchases can more than pay for the cost of using Elcide 75. Why not try Elcide 75 in your plant operation soon?

For more information or to place your order, write or phone:

ELCIDE 75™

PATENT PENDING

Lilly

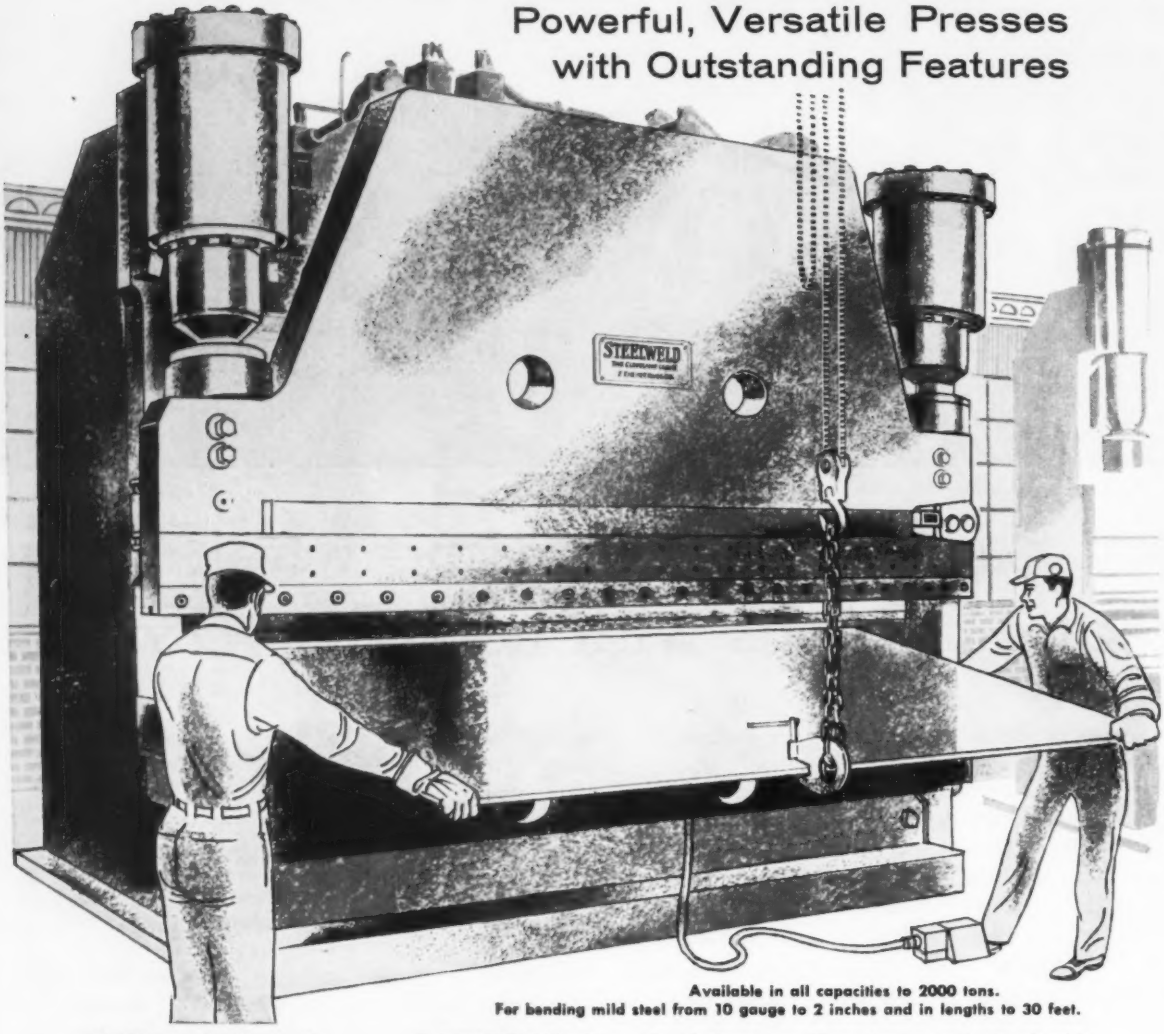
Lilly's brand of bacterial inhibitor for cutting fluids

ELI LILLY AND COMPANY, AGRICULTURAL AND INDUSTRIAL PRODUCTS DIVISION, INDIANAPOLIS 6, INDIANA. TELEPHONE: MELROSE 6-2211

STEELWELD

HYDRAULIC PRESS BRAKES

Powerful, Versatile Presses with Outstanding Features



Available in all capacities to 2000 tons.
For bending mild steel from 10 gauge to 2 inches and in lengths to 30 feet.

- **Positive overload protection.**
- **Constant power during entire stroke.**
- **Ram reversible at any point.**
- **Stroke quickly adjusted for any length.**
- **Fast ram approach and return—slow-speed pressing.**
- **Operating pressure simply adjusted.**
- **Accurate ram level automatically maintained.**
- **Ram easily tapered.**
- **Simple, safe to operate.**

HEAVILY built and of finest quality throughout, Steelweld Hydraulic Press Brakes are of the most advanced design with all features desirable for ease of operation, maximum production and finest performance.

They are versatile machines capable of handling a wide variety of operations. They are ideal for jobbing shops, as well as for mass-production work. They work to close tolerances and have ample speed.

We urge you to get the facts on these outstanding brakes that have so much to offer you.

Write for free copy of catalog No. 2024A.

STEELWELD

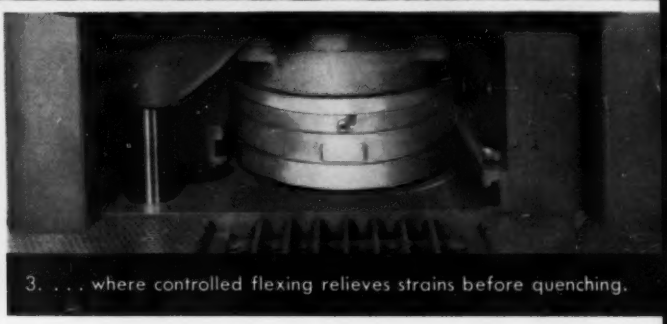
HYDRAULIC PRESS BRAKES

Other Steelweld Machinery:
Hydraulic Shears; Mechanical Shears and Press Brakes; One-Two- and Four-point Straight-Side Presses; Hi-Draw Presses.

THE CLEVELAND CRANE & ENGINEERING COMPANY • 5471 EAST 281st STREET • WICKLIFFE, OHIO

1. Work piece is gripped by loader arms . . .

2. . . . which move piece to quenching die . . .



3. . . . where controlled flexing relieves strains before quenching.

New Gleason machine quenches gears *3 times faster* with minimum distortion

The unique, fully automatic method incorporated into the new Gleason No. 117 Quenching Machine makes it possible to quench gears and other parts faster than ever before without significant distortion.

The machine discharges a piece every 30 seconds; accommodates 17 pieces in process at one time.

Automatic handling. Once a part is deposited at the front of the machine, the No. 117 positions it on a quenching die and then clamps, flexes, and quenches it. Initial quenching takes only about ten seconds.

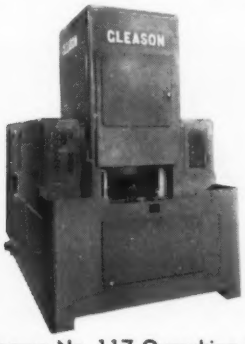
When the part cools past the critical hardening temperature, it is released from the dies. Still immersed in oil, the part then cools completely as it travels on a conveyor to the unload chute. As soon as part is released from dies, the machine is ready to receive another work piece.

Flexing before quenching. Each hot part is flexed between the dies to relieve internal stresses. Rate and number of flexes are easily preset. Hydraulic pressure produces positive diaphragming action.

Pulsing. All pressure on the work is pulsed momentarily throughout the die-quench. This permits work to contract without strain. During the die-quench, oil flows uniformly over and around the part.

Faster production. You can speed up production materially with the Gleason No. 117 Quenching Machine. It handles ring gears and cylindrical parts up to 10½″ in diameter and 8″ high. You can connect it with any conventional furnace so that parts are automatically fed to the quenching press. Push-button controls and timers are adjustable and easy to set. Dies can be changed quickly and easily.

Gleason engineers are ready to help you step up productivity with this new machine. For complete details, write for bulletin.



Gleason No. 117 Quenching Machine

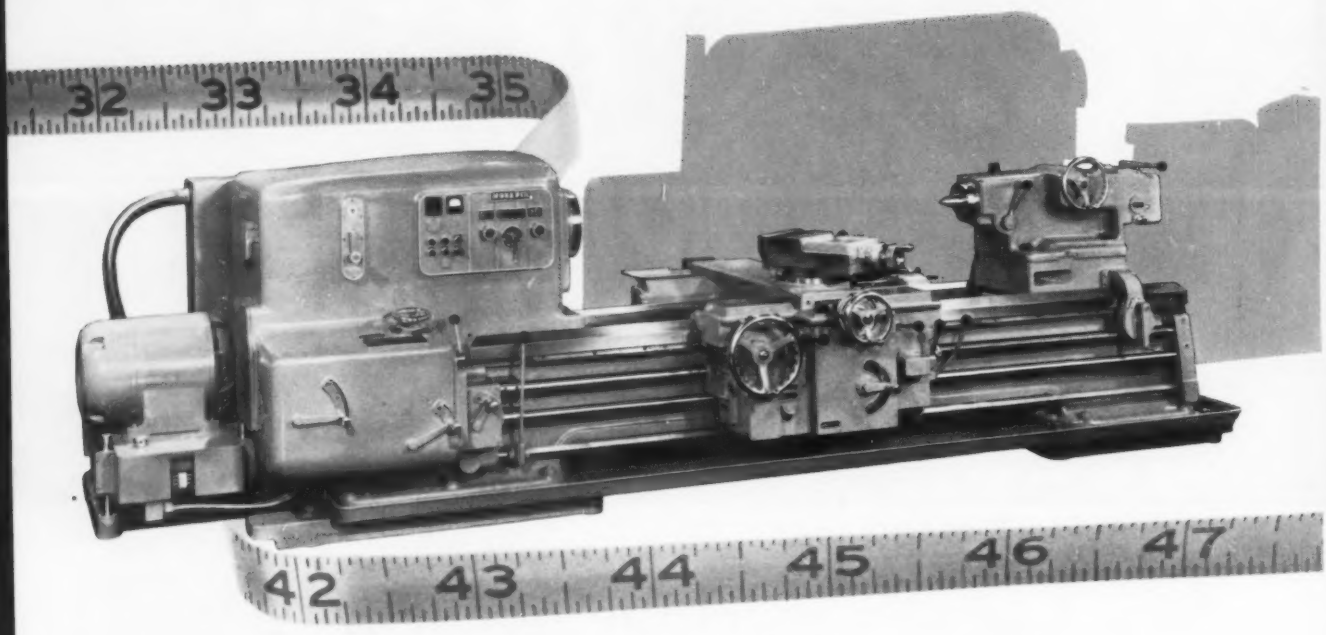
GLEASON WORKS

Builders of bevel gear machinery for over 90 years

1000 UNIVERSITY AVE., ROCHESTER 3, N. Y.

Only Another Monarch Series 90 can measure up to

This Lathe's productivity



Big work requires more than just a big lathe

Massive machine components and the necessary swing capacity don't fill the complete bill by far. The basic consideration is almost always greater production, therefore lowered costs.

You get this in the Monarch Series 90 Heavy Duty Dyna-Shift—an ultra-modern machine which will remove more metal at any speed than is possible on any other heavy duty lathes. Maximum production is assured because here is a machine that can be kept under full load during the entire cutting cycle. Major contributing factors design-wise are more machine output per unit of power input, less operator effort, reduced maintenance, ease of supervision. The Series 90 meets all these requirements as does no other heavy duty lathe — and the points discussed in this ad tell you why.

Production increases of 25% or more along with a similar improvement in tool life are a common experience for Series 90 users. There's the pay-off when you invest in the best—the cheapest in the long run. The Series 90 is available in three models ranging from 40″ to 48″ clearance diameter and 25″ to 36″ swing over the cross slide. Write for Booklet 1601.

THE MONARCH MACHINE TOOL COMPANY, SIDNEY, OHIO.

ELECTRICALS PLACED RIGHT

1. External main drive motor mounting and external electrical control mounting (either NEMA or JIC) for quick accessibility.

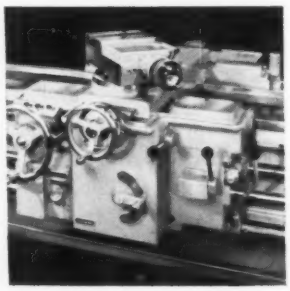
2. Motor mounted on hydraulic system sump also supplies power for hydraulic pump.

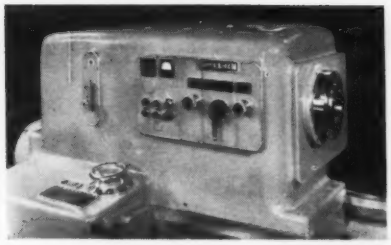
CONTROL CENTERED AT THE APRON

1. Electrically actuated power traverse, left or right, for fast carriage movement. Jogging for critical positioning may be accomplished any time desired.

2. Positive, cam controlled feed frictions. Application is such that machine never loses its chip under the heaviest of cuts.

3. All controls located to permit operation from a stand-up position—no stooping or stretching necessary.





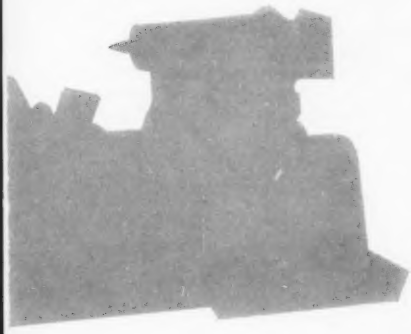
HEADSTOCK WITH A BRAIN

1. 36 speeds—range 6 to 750 R.P.M.—ratio 1 to 125. Standard range low enough, high enough and with plenty of speeds in between to provide reasonably constant surface cutting speed on most work.

2. Operator works in terms of surface cutting speed. Machine automatically figures correct R.P.M. and sets up shift. Operator sets two dials—one for work diameter, the other for desired surface speed. A speed indicator always shows the R.P.M. in engagement.

3. Flip of a lever gives free spindle in a jiffy. And there is a generous 4 1/16" hole through the spindle.

4. Hydraulic brake and clutch are self-adjusting for wear. Being under automatic machine control regardless of load, operator needs not supply power for engagement.



MACHINE CONTROL—EASY DOES IT

1. Series 90 controlled by a three-position lever at the apron. A duplicate lever close to the headstock is provided for setup purposes. With this lever, work rotation may be started or stopped and jogging may be accomplished.

2. Shifting, an operation performed many times each day, is at fingertouch ease and speed. Hydraulic power does the work of clutching, braking, gear shifting and jogging.

COMPLETE AUTOMATIC LUBRICATION

1. Headstock, end gearing and gear box served by single system of the filtered, combination mist-splash type.

2. Apron lubrication system of the circuited, metered and filtered type also provides oil to carriage guide ways and cross slide bearings. There is ample lubrication during both power and manual longitudinal and cross feed.

3. Separate tailstock lubrication system.

PROTECTED GEAR BOX AND END GEARING

1. Both the gear box and end gearing are totally enclosed. Lubrication is kept in, dirt kept out, original accuracy maintained.

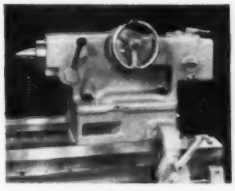
TOPS IN SAFETY INTERLOCKS

1. When machine is started, the brake engages automatically, preventing spindle rotation regardless of main control lever position.

2. No speed shift can be made with spindle rotating. More than anything else this preserves the original accuracy of headstock gearing.

3. Leadscrew and feed rod cannot be engaged simultaneously.

TAILSTOCK AHEAD OF THEM ALL



1. Either single speed or two speed range type available with dead or anti-friction center spindle. Sufficient mass, rigidity and spindle size (7" diameter) to support the heaviest of cuts.

2. Work piece expansion, due to heat, absorbed by heavy duty springs in the tailstock.

3. Handwheel located at front for convenience of operator when changing work pieces.

ADDED EQUIPMENT FOR ADDED PRODUCTION

1. Additional equipment in considerable variety is available for the Series 90 line. Consider, by all means, the advantages of the "Air-Gage Tracer," a means by which thousands of users have reduced costs substantially.

2. Ask for descriptive Booklet 1601 which not only describes the basic machine but the commonly used items of additional equipment and includes full specifications.

Monarch

ACCURACY • ECONOMY • LONG LIFE

TURNING MACHINES

FOR A GOOD TURN FASTER . . . TURN TO MONARCH

INSTANT SUPERVISION

1. At a glance, supervisor may check (a) work diameter setting, (b) S. F. P. M. setting and (c) H. P. consumption. This makes it possible easily and quickly for him to assure full productiveness of the machine and the operator at all times.

THE BED—FLAME HARDENED, ROCK-SOLID

1. All four bed ways flame hardened and precision ground to keep them factory-fresh for years to come.

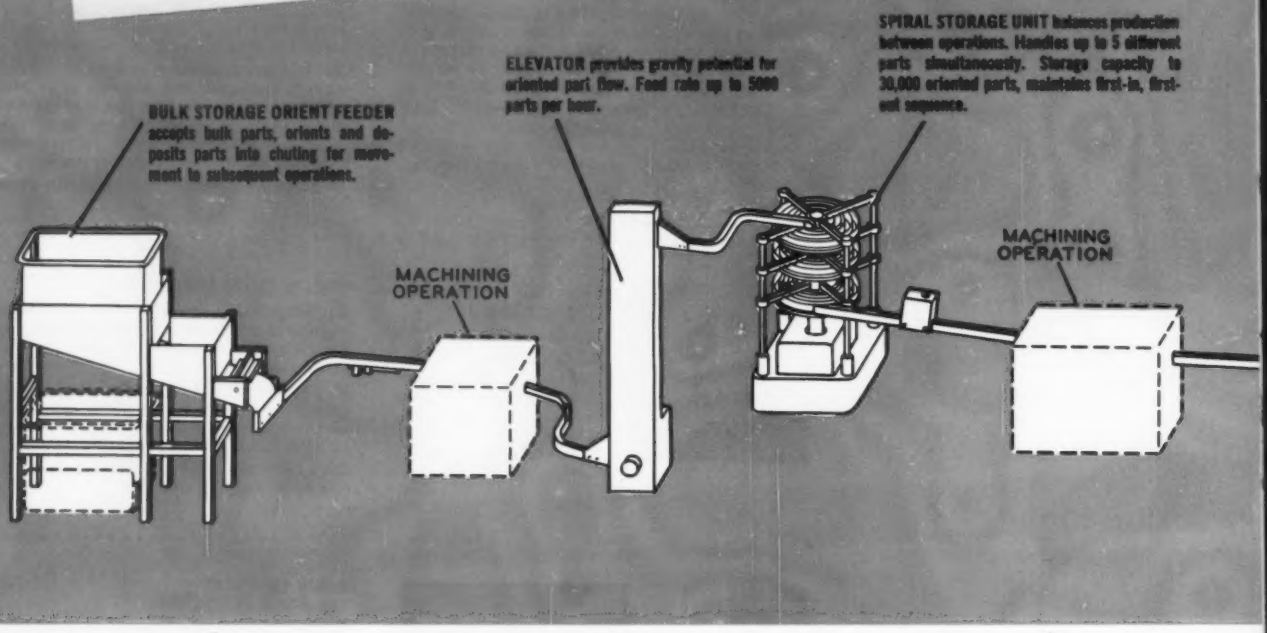
2. Triangular bridge type girth construction throughout entire center section provides stability needed for heavy duty work.

3. Longer machines equipped with traveling rod supports which are automatically picked up and dropped off by apron.

4. Dual pump coolant system, with electrical control on apron convenient to operator, guarantees ample coolant exactly where and when it is wanted without long and unsightly hose strung over machine.

NEW IDEAS IN AUTOMATIC

A NEW CONCEPT FOR AUTOMATION THAT IS ECONOMICAL, EFFICIENT, FLEXIBLE AND NON-OBSOLESCENT



LAMB Offers NEW LINE of Standard Units Having Unusual Versatility. One or More Will Solve Almost any Parts Handling Problem Using Existing Production Equipment.

Automatic parts movement between operations saves time, space and money. Until now, the specialized nature of such handling systems could not justify their cost except for long run production of parts that seldom required redesign.

The F. Jos. Lamb Co. has overcome this high cost factor by eliminating special design and providing flexibility in standardized units. Lamb standardization and flexibility in automatic parts handling equipment means that many of the benefits of automation are available at very low cost, simply by integrating existing production machine tools by the use of one or more Lamb components.

Added savings are realized when part design change, new part production and/or processing change would normally obsolete other systems. It means that many manufacturers who believe their operation is too small or unsuited to automated methods can now apply automation to a single process or to an entire plant.

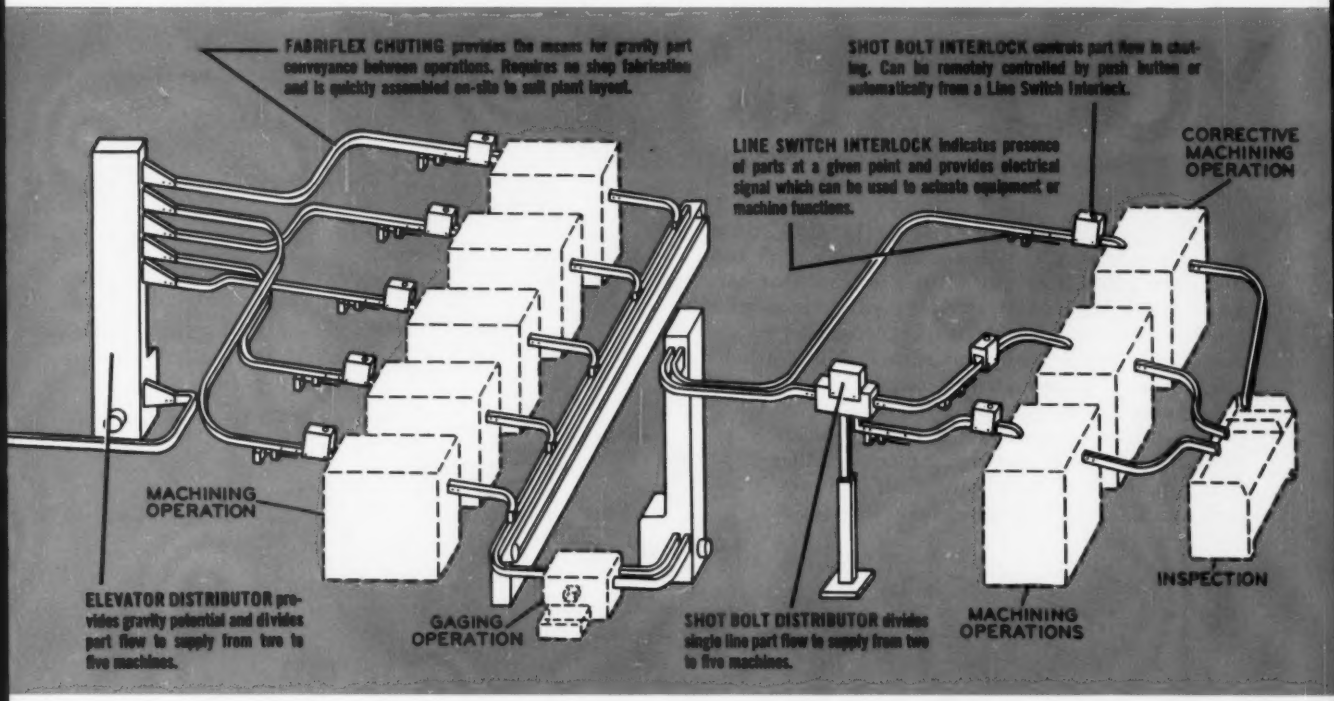
The Lamb concept of "packaged" automation provides a separate component for each automated function. One unit orients bulk parts. Another elevates parts for gravity potential. There is one that stores and feeds parts to balance production. Still another divides part flow to feed production from a fast cycling machine to two or more slower operations. Line interlocks control part flow and provide an electrical signal to control machine functions. All machines and the parts

F. JOS. LAMB CO.

P. O. Box 4611 • 5663 E. Nine Mile Road • Detroit 34, Michigan

PARTS HANDLING (and storage)

That CUT COSTS



handling units are tied together with Lamb FabriFlex Chuting which conveys parts between operations by gravity motivation. The drawing above illustrates the versatility of a Lamb system.

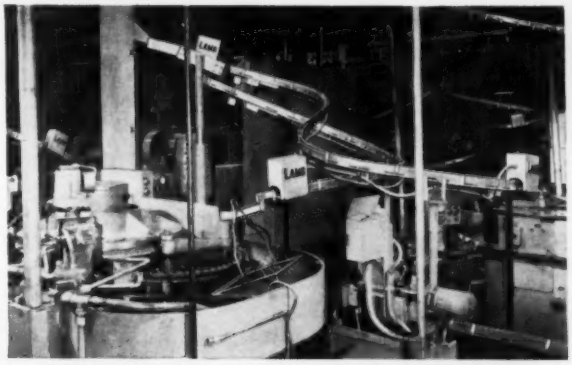
Investigate the advantages of this new concept today. Call in a Lamb engineer; his experience qualifies him to suggest ideas for cutting handling costs, increasing production, reducing down time, balancing production and automating your manufacturing using the equipment now in your plant.

8132

Write for this NEW Bulletin. It will give you Numerous Ideas on How to Cut Parts Handling Costs.

SINCE 1914

Engineers and Builders of Special Machines and Automation Equipment



This photograph shows Lamb Parts Handling Units used in the production of transmission gears. An elevator, flow divider, line interlocks and chuting are installed where required to provide completely automatic production. Normally, Lamb components can be installed without altering plant layout.

F. JOS. LAMB CO. M
P.O. BOX 4611, 5663 E. NINE MILE ROAD
DETROIT 34, MICH.

Please send me without obligation a copy of bulletin 58-01
LAMB AUTOMATIC PARTS HANDLING AND STORAGE

Name_____

Title_____

Company_____

Address_____

HERE IS THE GRINDER YOU ASKED FOR!

● A smaller (14" x 42" or 14" x 48" table) heavy duty, high precision surface grinder with controls at eye level retaining all the features that have made HILL horizontal spindle hydraulic surface grinders famous for precision production during the past twenty years. This is an entirely NEW grinder brought out at your request to compliment the line of HILL heavy duty surface grinders of larger sizes. Where initial cost and limited floor space are critical factors we believe that this new, smaller HILL grinder will solve your finer finishing problems. Full details are given in bulletin 58GS.

HILL Horizontal Spindle grinder with fully hydraulic table and cross feeds. Size: 14" x 42" table with 16" clearance. Magnetic chuck is standard equipment.

Of course we still make the full line of HILL horizontal spindle and vertical spindle grinders in the larger sizes with table lengths from 5 to 20 feet.

THE HILL ACME COMPANY

1207 W. 65th STREET
CLEVELAND 2, OHIO

HILL ACME TOOLS FOR INDUSTRY

Manufacturers of: "HILL" Grinding & Polishing Machines — Hydraulic Surface Grinders — "ACME" Forging — Threading — Tapping Machines — "CANTON" Alligator Shears — Billet Shears — "CLEVELAND" Knives — Shear Blades

"The Board balked at first...

but I convinced them that now was a good time to buy!"

When machine tool builders work with smaller backlogs they're naturally more efficient and can make better deliveries...are more able to control costs ...more able to render the many *extra* custom engineering services that disrupt regular production during peak schedules. As a matter of fact, many progressive buyers are at their busiest now...taking advantage of the sound buying position the economy gives them as it pauses for its breath...seizing the opportunity to get ready for tomorrow today.

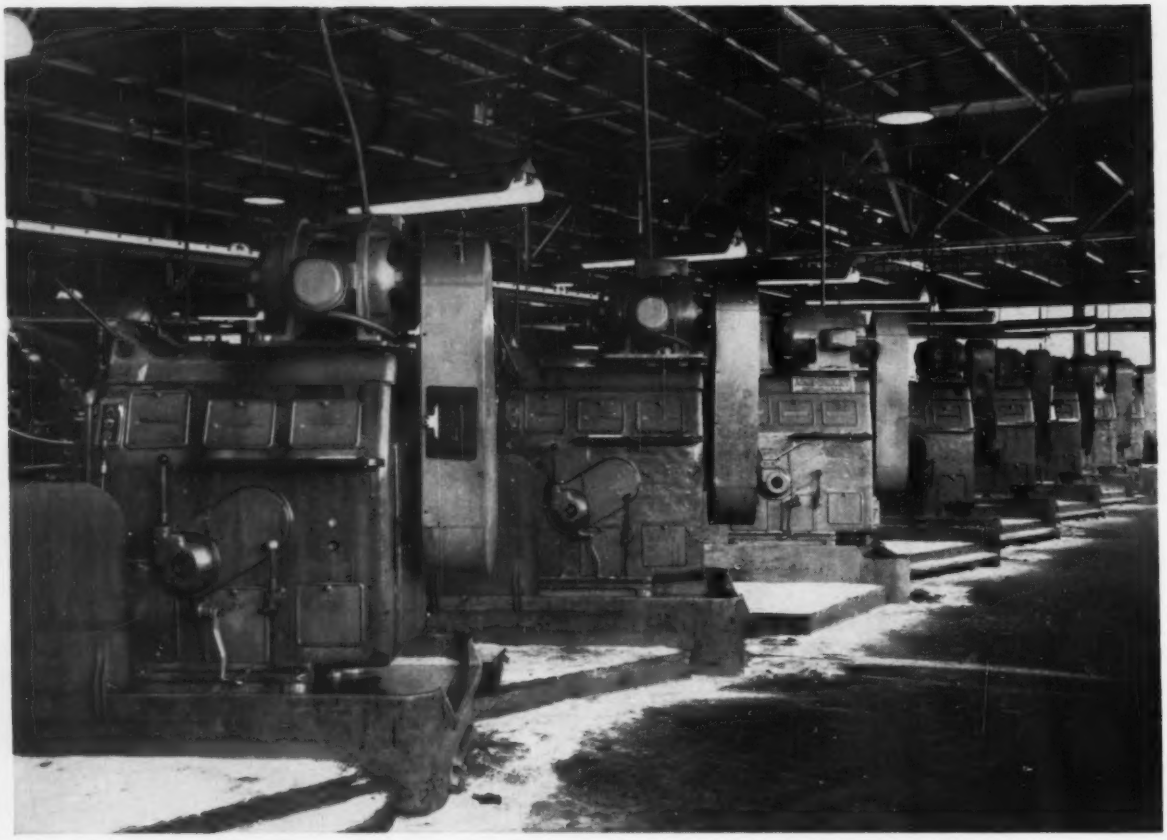
BLISS
SINCE 1857

E. W. BLISS COMPANY · Canton, Ohio

BLISS is more than a name...it's a guarantee

PRESSES • ROLLING MILLS • ROLLS • DIE SETS • CAN MACHINERY • CONTRACT MFG.

For more data, circle this page number on inquiry card



Lundberg cuts costs 11% by switching to Timken® hot-rolled seamless steel tubing on National Acme screw machines

TO cut costs, Lundberg Screw Products Company of Lansing, Michigan, investigated the possibility of using hot-rolled tubing on its National Acme screw machines. The question: were hot rolled tolerances adaptable to standard collets.

Timken Company sales engineers suggested they try hand chucking. Although hand chucking would mean a slight increase in time due to minor adjustments of collet tension, the material savings would more than offset the higher labor cost. And it did. The manufacturer found these adjustments added 1/10 of an hour per tube to production time. *But* the saving in material cost was *11%*.

Can hot-rolled Timken® seamless steel tubing save money for you? Call us and see. And to further increase your steel savings, ask Timken Company engineers to recommend the most economical tube size for your hollow parts job. We'll guarantee this size to clean up to your dimensions. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable: "TIMROSCO". Makers of tapered roller bearings, fine alloy steels and removable rock bits.

Timken alloy steel and seamless tubing is available from warehouse stock in 44 cities in the United States. Call your local Timken Company sales office for the name of your nearest Timken steel distributor.

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SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS STEEL TUBING

A flexible automated machining center *that unifies milling, drilling, reaming, tapping and boring operations* ***in a single machine***

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*a machine that harnesses the **full** potentia*

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reaming, tapping and boring operations in a s

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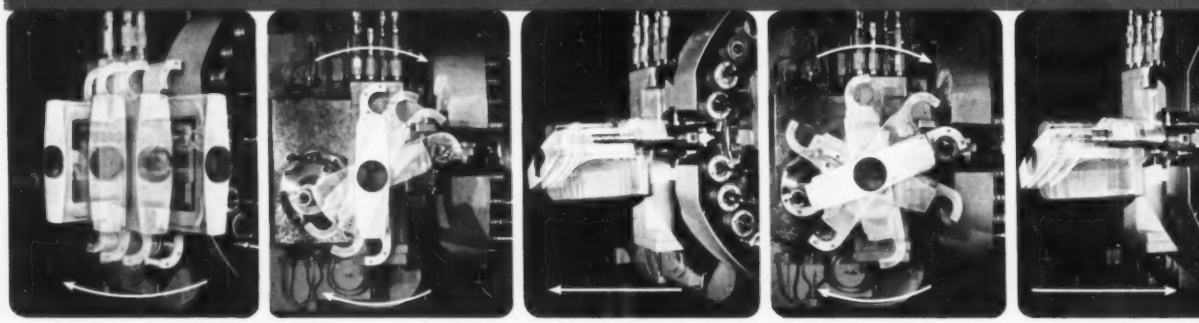

In a matter of seconds this exclusive **MILWAUKEE-MATIC** *feature changes your production schedules from* ***MONTHS TO MINUTES!***

Here's what MILWAUKEE-MATIC means to your operations

The MILWAUKEE-MATIC is the *most significant achievement* of the machine tool industry in the last 50 years. Briefly, it is a single machine that performs the many operations that are normally accomplished on several other machines to complete a part. MILWAUKEE-MATIC will improve almost every aspect of administrative planning—from plant management and finance to engineering and production.

- **Offers flexible automation for job-lot producers through numerically controlled positioning, straight-line milling, arcs and slopes, tool selection, indexing and speeds and feeds.**
- **Cuts working capital requirements... balances inventory.**
- **Boosts machine cutting time by as much as 75% by applying off-machine workpiece set-up.**
- **Slashes tooling cost... savings can pay for MILWAUKEE-MATIC in one to three years.**
- **Reduces lead time from months to days... permits rapid new product introductions and product changes.**

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milling, drilling,

single machine

Program Controls
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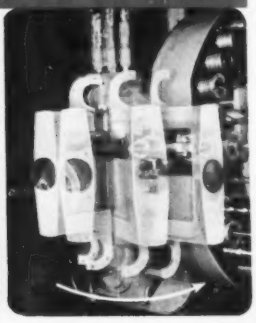
GENERAL ELECTRIC

FLEXIBLE AUTOMATION

IN ACTION



I

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898

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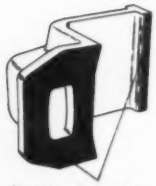
How MILWAUKEE-MATIC *saved $1637.89* on tooling costs alone compared to conventional machining methods

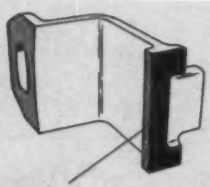
Motor bracket.

DESCRIPTION	CONVENTIONAL	MILWAUKEE-MATIC
Cycle time	38.7 min.	15.37 min.
Set-up time	4.62 hrs.	.25 hrs.
Tooling	$1894.00	$256.11
Savings on tooling costs alone . . .		$1637.89

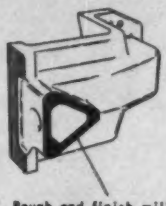
® Trademark Reg. U.S. Pat. Off.



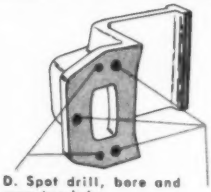
A. Rough and finish mill two surfaces. Time, 2.51 min.



B. Rough and finish mill one surface. Time, 1.36 min.



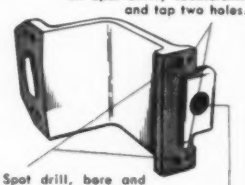
C. Rough and finish mill one surface. Time, .89 min.



D. Spot drill, bore and ream two holes.

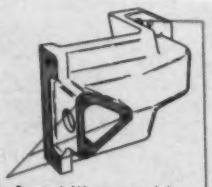
E. Spot drill and drill 3 holes. Time, 3.42 min.

G. Spot drill, countersink and tap two holes.



F. Spot drill, bore and ream two holes.

H. Spot drill, drill and bore one hole. Time, 4.19 min.



I. Spot drill, countersink and tap three holes.

J. Counterbore three holes (in back.) Time, 3.00 min.

Only one single holding fixture and one set-up required to perform 49 operations described above.

CONTACT THESE MILWAUKEE-MATIC SALES REPRESENTATIVES

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Jackson-Fotsch Co.
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Syracuse Supply Company
1965 Sheridan Drive

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Wm. S. Boldon Co., Inc.
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6800 W. National Ave.

MOLINE, ILL.
Jackson-Fotsch Co.
2920 25th Ave. "A"

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Stauss & Haas, Inc.
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OMAHA, NEB.
Fuchs Mach. & Supply Co.
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- ☐ Have Kearney & Trecker representative call me for MILWAUKEE-MATIC film demonstration appointment.
- ☐ Send me new MILWAUKEE-MATIC Bulletin.
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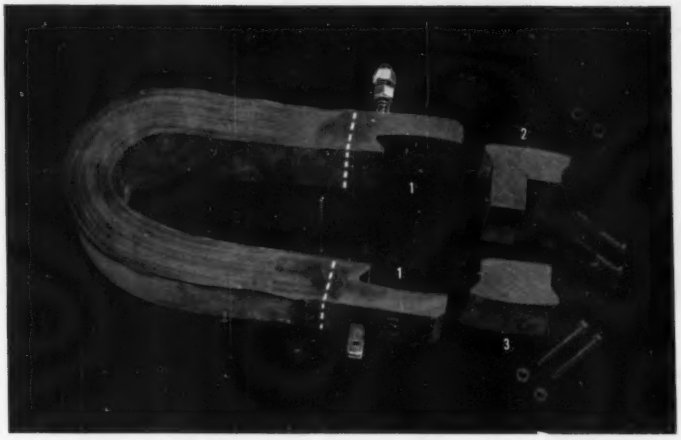
See Milwaukee-Matic film demonstration in your plant or at your nearest Kearney & Trecker distributor's office

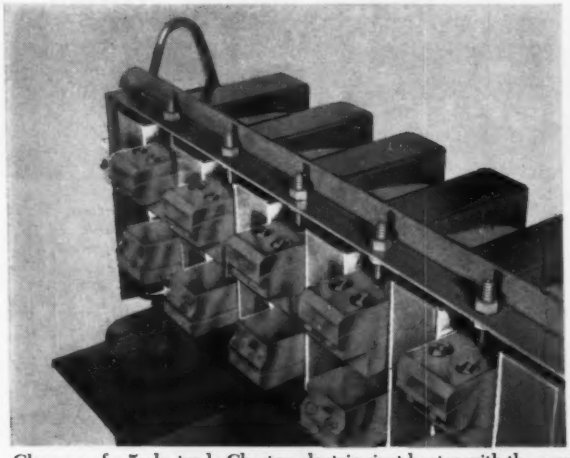
$70 COST CUT for each electrode assembly—through use of Anaconda extruded copper shapes—helped Frank C. Cheston Co. add replaceable contact feature in its line of electric rivet heaters.



Electric rivet heaters are tough, simple machines that have for years been saving time and money in riveting operations. But Frank C. Cheston Co., Newark, N. J., saw a chance to save its customers some money in maintenance, too, by making electrode-assembly contacts easy to remove for resurfacing or replacement.

Originally these contacts were integral with the laminated copper conductor forming a one-turn secondary in the step-down transformer. In redesign, only parent blocks (1, at left) are welded to the conductor. Contact shoes (2 and 3), which mate precisely with parent blocks for unimpaired conductivity, are easily removed by unbolting*.

Machining pieces 1, 2, and 3 from copper bar stock ran costs so high that the price of the heater would have become unrealistic. American Brass specialists were consulted and precisely shaped extrusions of high-conductivity copper were produced, from which the finished sections are cut. Tolerances were closer and surfaces finer than with machining—and costs per electrode assembly were cut $70.



Close-up of a 5-electrode Cheston electric rivet heater with the new removable contact feature for easier maintenance. Savings from use of Anaconda extrusions enabled Cheston to include this new feature at practically the same price as heaters of previous design.

Cheston electric rivet heater in use showing how step-design of upper contact (2, in illustration above, left) makes it easy to heat both long and short rivets. Contacts are opened by foot pedal and contact pressure is maintained by springs seen just above the pedal.

CUTTING shop costs may be easier than you think. Take a fresh look at the way you're making metal parts. Make a note of any part you suspect might benefit by the use of extrusions, special-shaped tube, die-pressed forgings, etc. Then call in your American Brass Company representative and talk it over with him. He will see that your problem gets to the right Anaconda technical specialists promptly and will expedite the answer. Or write: The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda Brass, Ltd., New Toronto, Ontario.

5858

Bolts are of Everdur®, Anaconda copper-silicon alloy.

DIE-PRESSED FORGINGS · SPECIAL-SHAPED TUBES
EXTRUSIONS · FABRICATED METAL PARTS

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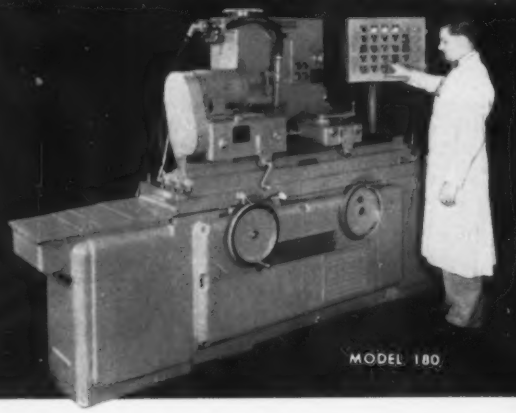
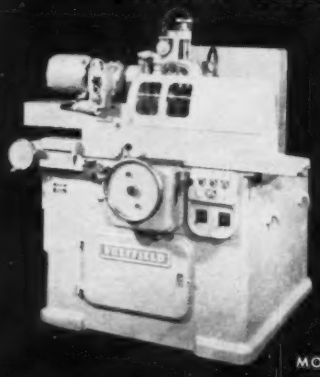
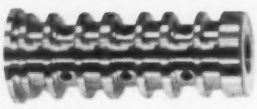
Grind PRECISION FORMS, GROOVES and LANDS *in Record Time* with SHEFFIELD'S CRUSHTRUE MULTIFORM GRINDERS



MODEL 180



MODEL 109

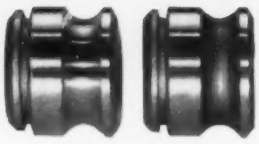


Servo Mechanism Sleeve

The seven grooves of this servo mechanism sleeve are crushtrue ground from the solid to a tolerance of .001" on spacing and .002" on minor diameter in 55 seconds. Material, SAE 52-100; Rockwell, 58-60 C; depth of plunge grind, .145".

Forms and grooves are precision ground on these machines with comparable speed and economy.

For complete details write to Department 9. The Sheffield Corporation, Dayton 1, Ohio, U.S.A.

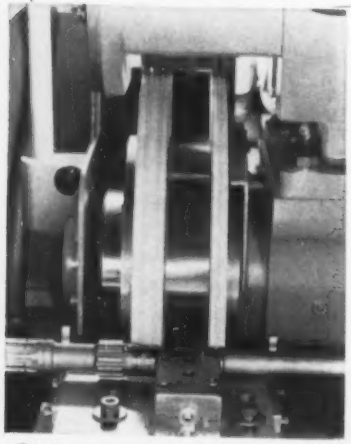


Bearing Race

Aircraft Servo Component

Hydraulic Servo Units

Self-aligning Bearings



Grinding Grooves in a Transmission Shaft

Crushtrue Roll

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manufacture and measurement for mankind

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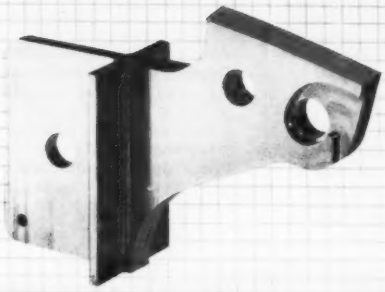

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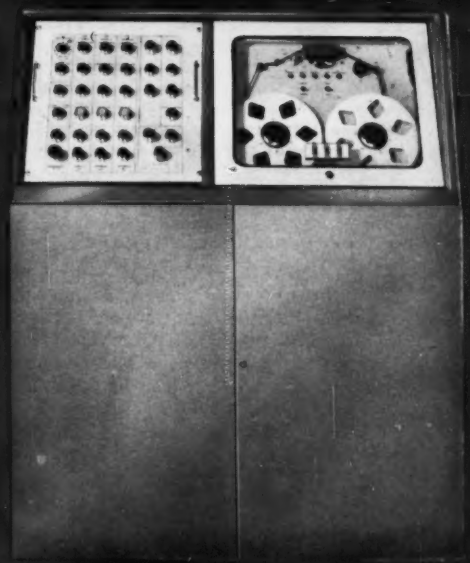
CONTOURING CONTROL SYSTEM

Lowest priced high performance control now being marketed for heavy duty machine tools. Compact, efficient design. Reliable, easily maintained construction. Simple to learn and operate. Fifteen Model 180 control systems, combined with contour milling machines, are being delivered to Air Force contractors to provide shorter lead times, new design freedom and faster, lower cost production.

Handles any size boring mill, profiler, vertical turret lathe, bed-type milling machine or lathe. Gives three-axis coordinated control with up to 180 inches per minute cutting rate. Designed for ±0.001-inch control accuracy; officially tested at ±0.00025-inches. All around finest machine tool control system available today.

Write for 12-page "Model 180 Control System" Catalog.



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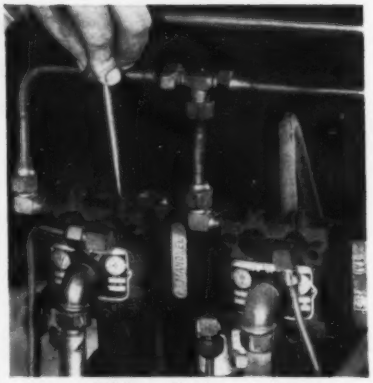
Division of
STROMBERG-CARLSON
DIVISION OF GENERAL DYNAMICS CORPORATION
2231 S. Barrington Avenue · Los Angeles 64, California

*DIGIMATIC is our trademark

Why Skinner 4-way solenoid valves are used so widely for cylinder control

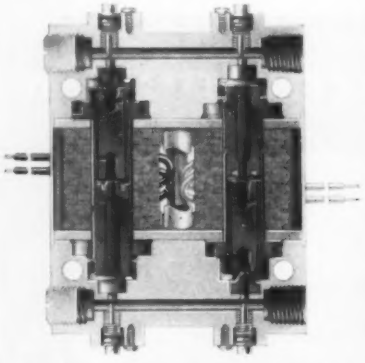
Application: A longitudinal and a transverse slide in this Pratt and Whitney Electrolimit Jig Borer is positioned automatically from numerical data on punched tape or manually by decade dials. When each slide has been correctly positioned it is held firmly by air-actuated, non-influencing clamps. Each clamp is controlled by a cylinder and a Skinner four-way V9 valve.

Features of standard valve did job. No special engineering of the four-way V9 valve was required to meet Pratt and Whitney's need. Molded oil-proof coils are used to guard against burnout from cutting solutions. The Skinner valve makes an ideal cross connection between electrical sensing and the muscular air required to provide the clamping action.



Dependable cylinder control. The four-way V9 valve is available with adjustable flow features in the main stream and in the exhaust passage for exceptionally accurate cylinder control. Position of inlet and exhaust connections can be changed easily in the field by simply reversing plugs.

Skinner V9 four-way valves, actually two 3-way valves in one housing are offered normally closed-normally closed, normally open-normally open, and normally closed and normally open. Media: air, inert gases, hydraulic fluids and vacuum; orifices: 3/64" to 1/8"; NPT ports: 1/4"; pressure ratings: to 250 psi. Over 350 basic variations.



Quality workmanship throughout. Internal parts are stainless steel and highly corrosion-resistant. Durable, compressible inserts of soft, synthetic materials insure bubbletight operation. Orifice seats have radius with well-rounded contact area and high finish for long insert life. Valve can be mounted in any position.

Exceptional life expectancy. Skinner valves, engineered to the highest UL standards, are life-cycled in the lab at speeds as high as 600 cycles per minute. In these tests, the V9 valves regularly get over 20-million cycles without leakage. And these results are constantly proving out in service.

Skinner solenoid valves are distributed nationally.
For complete information, contact a Skinner Representative listed in the Yellow Pages or write us at Dept. 551.

SKINNER ELECTRIC VALVES
THE CREST OF QUALITY

SKINNER ELECTRIC VALVE DIVISION
NEW BRITAIN CONNECTICUT
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- Export Regulations Changed
- Missilemakers Eye Heavy Presses
- Washington Briefs

Keeping up with Washington

Loring F. Overman

Export Regulations Changed

Machine tool industries emerged about even Steven in the recent revision of export-control requirements announced by the Commerce Department. The new regulations, detailed in Export Bulletin 806, add eighty items to the Department's "Positive List" of commodities that cannot be shipped to certain countries, and at the same time remove 250 items. Those removed may now be shipped under general export licenses to all countries outside the Sino-Soviet bloc, Hong Kong, and Macao.

In the machine tool and metalworking fields, twenty-seven items are removed from the list, twenty are added, and fifty-three revisions are cited. Remaining on the list are 120 classifications of machine tools and metalworking machines, most of them suitable for the production of arms and ammunition. The Metalworking Equipment Division of the Business and Defense Services Administration considers that the changes represent a slight net gain from the viewpoint of machinery exporters. The revisions implement export-policy changes previously announced by ex-Secretary Weeks after a review of international security considerations by the United States and fourteen other free-world nations.

The changes are the first of a major character made since a similar review in 1954. In announcing them, a Commerce Department spokesman said: "Scientific, technical, and industrial progress during the past four years has made it necessary to re-examine the applicability of the security concepts on which our export controls are based. Many of the items under control were found to be unjustified because of technological and industrial advances or increased availability to the Sino-Soviet bloc from indigenous or other sources.

"In revising export controls, efforts were made to achieve the necessary safeguards in the interest of the United States and free-world security, while at the same time imposing minimum interference with the conduct of normal international trade by United States industry and business."

Copies of current Export Bulletin 806 can be secured by writing the United States Department of Commerce, Bureau of Foreign Commerce, Washington 25, D. C.

Missilemakers Eye Heavy Presses

How can the Defense Department's heavy presses be employed to best advantage in the shift from planes to missiles? This question will be a continuing topic of discussion in Washington, in the three forging and five extrusion plants comprising the DOD's heavy-press program, and among many manufacturers of missiles.

More than 200 interested persons attended a conference arranged by the Air Force during November at its heavy-press facility operated by Wyman-Gordon in North Grafton, Mass. Preliminary indications, according to Air Force spokesmen, are that the missiles program will not represent an expansion in the operation or output of the heavy presses. The presses have been used extensively in making military aircraft frames and engines for the B-47, B-52, F-102, and other planes.

Task forces are now studying the possibility, suggested by the Air Materiel Command, that the heavy-press equipment might be used in fabricating one-piece tank headers of conical or spherical shape. Use of the machines to forge structural beams which transmit loads from the engines to the tanks and outer skins has also been considered, particularly where several engines are grouped. Another possible use is for rocket-engine fuel pumps.

Washington Briefs

New Marking Instructions: New instructions and directives relating to the marking of specified types of metalworking machinery have been issued by the Defense Department. Instruction 4215.15 specifies methods of marking all metalworking machines costing more than $500 of the types covered in the Department's Directory of Metalworking Machinery, under Production Equipment Codes 3411 through 3419, and 3441 through 3449. The new instructions also provide that where items are not listed in the Directory, a request for a Production Equipment Code number should be directed to the Armed Forces Supply Support Center.

Inventions Wanted: Civilian inventors have been invited by the Office of Technical Services, Department of Commerce, to try their hands at solving eighty-two additional technical problems puzzling the defense agencies. This brings to 380 the number of problems for which solutions are sought. Areas involved include aerodynamics, missiles and space travel, applied mechanics, automotive and equipment engineering, chemistry, electricity and electronics, instrumentation, testing and measurement, metallurgy and metal fabrication, and freight handling. The list, entitled "Inventions Wanted," can be secured from the Office of Technical Services, Department of Commerce, Washington 25, D. C.

Space Capsule, Anyone?: The National Aeronautics and Space Administration expects to award a contract early in 1959 for the design of a space capsule weighing possibly one ton, capable of keeping a man in orbit around the earth for a minimum of some thirty hours. The capsule is being considered by the Advanced Research Projects Agency of the Department of Defense.

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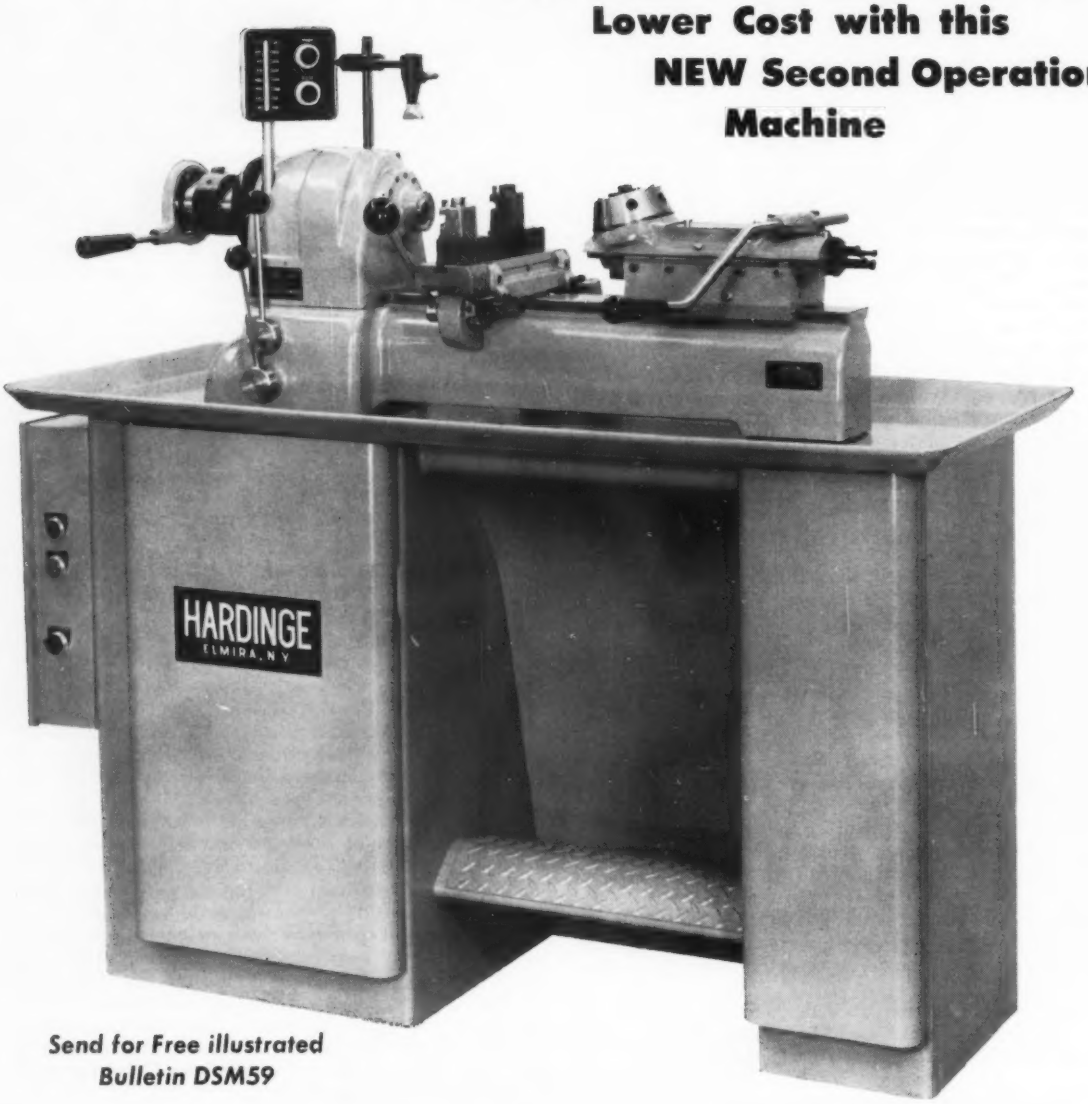
ELMIRA, N.Y.

Variable Speed Machine
for
PRODUCTION DEPARTMENTS

Produce More Precision Parts at Lower Cost with this NEW Second Operation Machine



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OFFICES IN PRINCIPAL CITIES. Export office: 269 Lafayette St., New York 12, New York

Machinery
JANUARY 1959

Prospects Look Decidedly Better

PROGNOSTICATORS can make predictions for this year's business in machine tools and allied equipment with far less reservation than a year ago. At that time a recession was definitely in progress, and while economists hoped for a recovery before the end of 1958, any statements to that effect were made with fingers crossed.

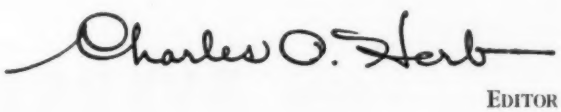
Today the gross national product index is rapidly returning to its all-time high established in 1957. Predictions are that it will attain the unprecedented level of $475,000,000,000 in 1959. This indicates a nation-wide prosperity that has not yet reached capital-goods manufacturers with full force. The indications are, however, that waves of business to this facet of industry will soon be appreciably higher.

A recent bulletin issued by the National Machine Tool Builders' Association stated that in October net new orders for both metal-cutting and metal-forming machine tools hit the high point of 1958. In the domestic field orders reached $32,050,000, and orders for both the domestic and foreign markets attained a total of $37,000,000. This was 30 per cent above the September total.

While the improvement in business was not uniform throughout the industry, the upturn points toward increased sales in 1959 over 1958. An analysis of economic and capital goods factors indicates that October may well have been the upward turning point in the machine tool industry following ten months of recession.

Another indication of what lies ahead may be obtained from figures just published by the Machinery Dealers National Association which announces that the sales of used machine tools in October were 13.3 per cent greater than the total sales in September, and the sales for that month were 21.7 higher than for August. The October sales were 18.3 per cent above those for the same month in 1957.

These signs are obviously encouraging. Rosier skies are ahead for the metalworking industry and for the suppliers of equipment to the many branches of that industry.



EDITOR

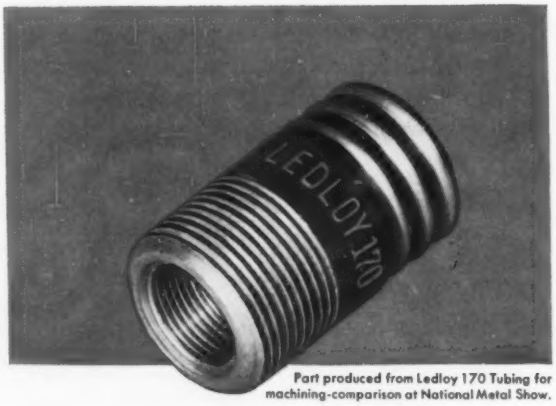
NEW LEADED STEELS FROM RYERSON

Now, machine parts faster than ever before

NEW LEDLOY 170 TUBING

average machining speed 170 surface feet per minute

Here's the fastest-machining steel tubing ever produced —and only Ryerson has it available for immediate shipment from stock. Ledloy® 170 is a cold drawn, seamless product of low carbon analysis with .15% to .35% lead added. It promises a minimum increase of 25% in productivity of machined parts or components. Sizes range from 1″ to 2½″ O.D. with maximum ⅜″ wall thickness. Other sizes can be supplied promptly.



Part produced from Ledloy 170 Tubing for machining-comparison at National Metal Show.

NEW LEDLOY 375 BARS

average machining speed 375 surface feet per minute

This newest addition to Ryerson free-machining screw steel stocks is the world's fastest-machining steel. Assigning the figure 100 to B-1112 and using this as a base, Ledloy 375 has a machinability index of 205 plus. It rates about 64% higher than B-1113 and about 20% higher than Ledloy 300.

Ledloy 375 bars presently in Ryerson stocks include rounds in sizes from ¼″ to 1″, hexagons ¼″ to ⅝″.

Ask your Ryerson representative for complete details on these new steels. And call Ryerson for an unequaled selection of cold finished bars and tubing, including the largest stocks of Ledloy 300 (also known as Ledloy A) and Rycut® leaded alloys—the fastest machining in their carbon ranges.

MACHINING COMPARISON*
Ledloy 170 Tubing vs. Nonleaded Tubing

	Ledloy 170		MT-1015	
	Speeds	Feeds	Speeds	Feeds
Center drill	172 s.f.m.	.005″	110 s.f.m.	.005″
Form tool	172 s.f.m.	.0008″	110 s.f.m.	.0008″
Boring tool	172 s.f.m.	.007″	110 s.f.m.	.007″
Cutoff	172 s.f.m.	.0013″	110 s.f.m.	.0013″
Thread	27 s.f.m.	—	20 s.f.m.	—
Tap	18 s.f.m.	—	12 s.f.m.	—
Production time	35 seconds		49 seconds	

* As demonstrated at National Metal Show, Cleveland, 1958.

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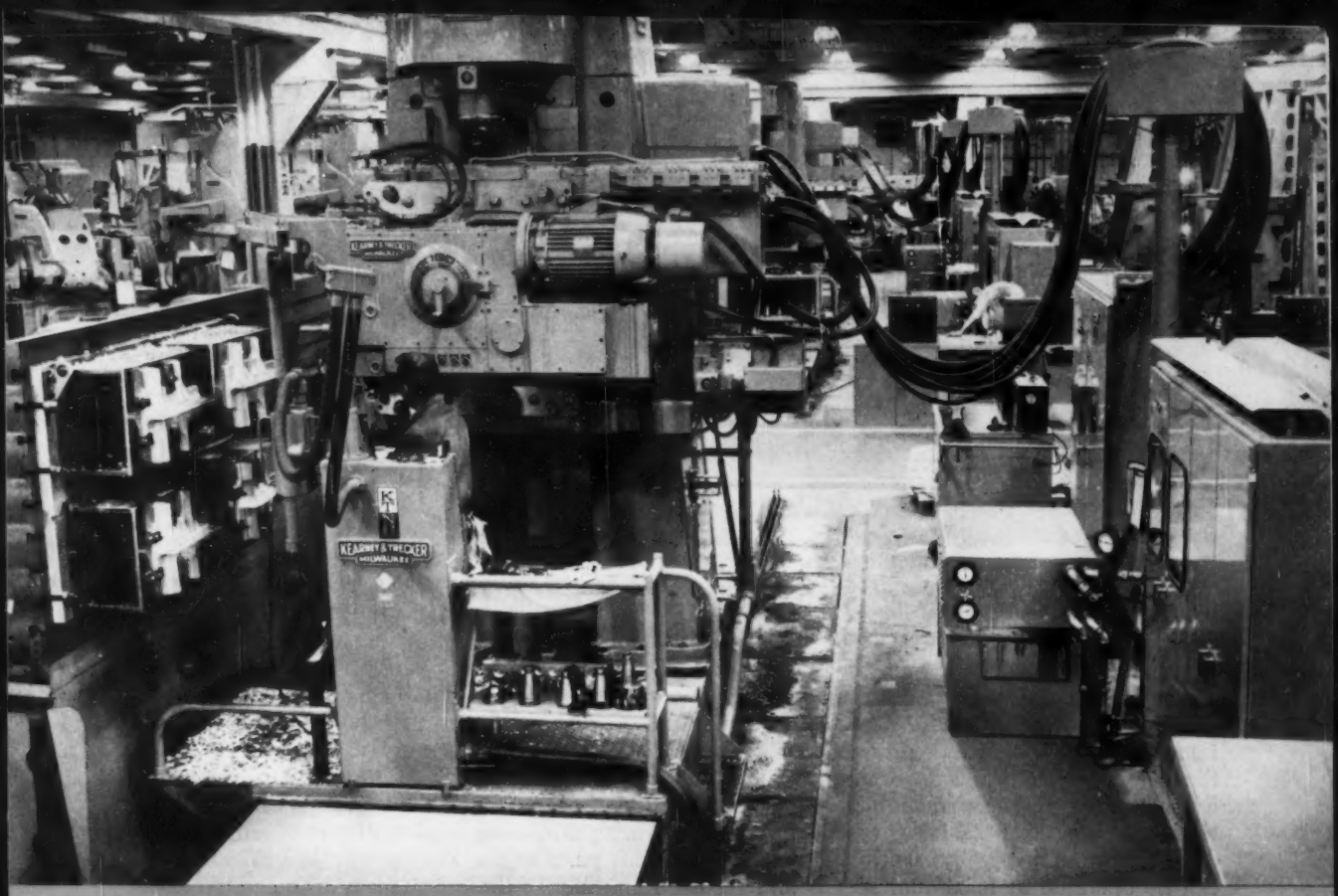


NUMERICAL CONTROL *IS* ECONOMICAL

In order to expedite delivery of B-52G missile-platform bombers to the Air Force, Boeing has turned to numerical control and found it both economical and efficient for the production of many complex, contoured parts. Savings of up to 80 per cent have been realized by this method.

MACHINING THE CONTOUR of a work-piece in a continuous operation on numerically controlled equipment is a relatively new concept in manufacturing. Today, not only can a machine tool be made to function automatically from instructions recorded on punched tape, but in the preparation of the control tape, engineering design and manufacturing information can be processed automatically by a computer. In short, numerical control influences the over-all production system from the engineering drawing to the finished part.

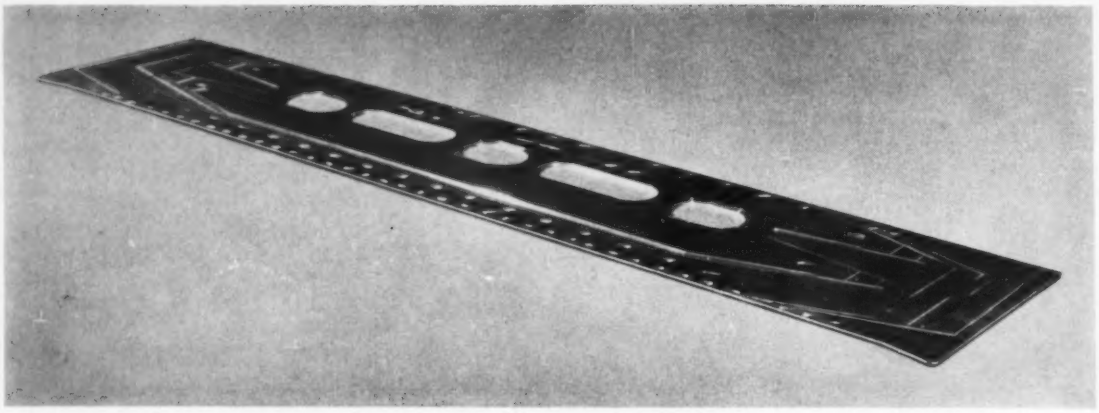


Fig. 1. Production lead time and machining time were reduced by the numerically controlled milling of reinforcing doublers. Surface finish is also improved.

Opportunities exist for applications of numerical control wherever machine tools represent an important element of the production facilities. Since no templates, cams, models, or complicated fixtures are required, savings in production lead time are possible. Machining costs are also reduced, since numerically controlled equipment can be operated at maximum speeds and feeds during all parts of a cycle without stopping for intermediate inspections or setups. This system reduces scrap rates to a minimum by eliminating much of the human error and increases tool life by loading the tool correctly at all times. Cost savings as high as 80 per cent have been experienced on various parts in the relatively short time such machines have been in use.

Three numerical-control systems of a type developed and built by the Industrial Controls Section of the Bendix Aviation Corporation, Detroit, Mich., are being used in the production of aircraft parts at the Boeing Airplane Co., Wichita, Kan. Each of these systems is arranged to control a Kearney & Trecker profile-milling machine (heading illustration) in expediting operations on forgings and castings for the B-52G missile-platform bomber.

To machine the reinforcing doubler seen in Fig. 1, the numerically controlled equipment per-

Fig. 2. Forged-aluminum vent splice fittings milled on numerically controlled equipment at a 55 per cent saving in machining time and a substantial reduction in tooling time.

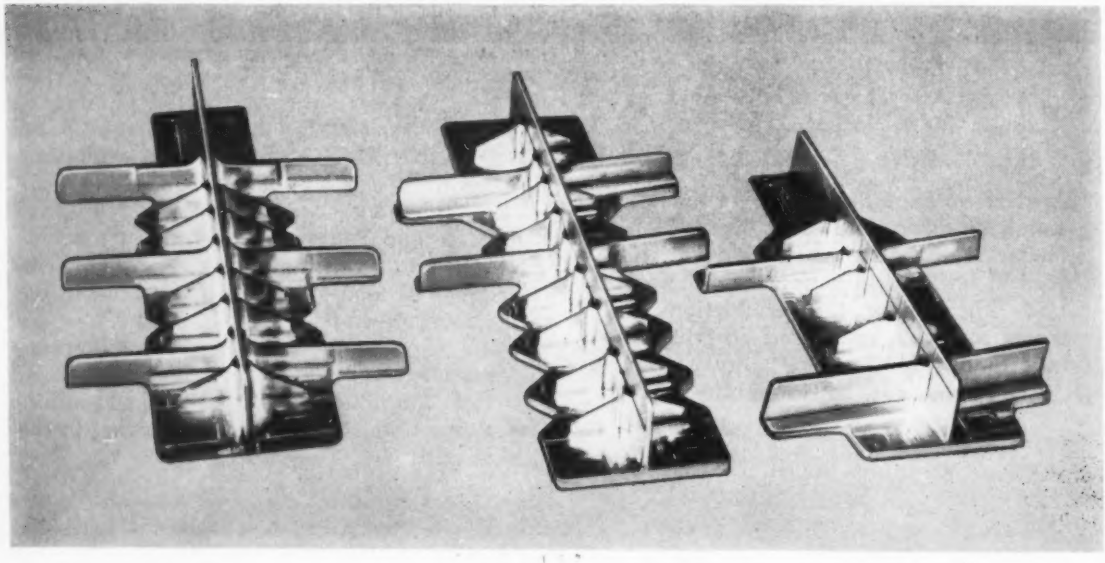


Table 1. Time Comparison Showing Savings Accomplished by Machining Reinforcing Doublers (Fig. 1) by Numerical Control

Machining Method	Conventional	Numerical Control
Lead Time	5 days	1 day
Machining Time (First Part)	25 hours	1.2 hours
Machining Time (Production)	6 hours	1/2 hour
Hand Finishing	120 minutes	10 minutes

Table 2. Time Expended in Tooling for and Machining the Forged-Aluminum Vent Splice Fittings Illustrated in Fig. 2.

Machining Method	Conventional	Numerical Control
Tooling Time	(Hours)	(Hours)
Tool Design	300	200
Tool Fabrication	2100	1500
Production Planning	80	300
Data Processing	0	10
Machine Setup	18	10
Total	2498	2020
Machining Time Per Part	18	8

forms surface, profile, straight-line, and circular cutting operations on aluminum. The results, as shown in Table 1, are an 80 per cent saving in lead time and a 90 per cent saving in machining time. In addition, the time required for hand finishing has been reduced from two hours to ten minutes because of the smoother surface finish achieved. During the machining of this part, the flat, circular, and profiled portions are milled at a feed rate of 80, 15, and 60 inches per minute, respectively. A spindle speed of 3600 rpm is employed in each case.

The numerically controlled machine effects a continuous contour-milling operation in producing forged-aluminum vent splice fittings (Fig. 2). As shown in Table 2, the new method saved 478 hours in tooling time and reduced machining time 55 per cent. During the machining of this part, a spindle speed of 1800 rpm is used on both the roughing and finishing cuts. The feed rate for roughing is 10 inches per minute and for finishing, 15 inches per minute. Machining of an aircraft fitting by the numerically controlled milling machine is seen in close-up in Fig. 3.

In a third application, pocket type, continuous contour-milling operations are performed on another forged-aluminum fitting (Fig. 4). Comparative results are described in Table 3. In this case, numerical control saved 1004 hours in tooling time and reduced machine time 35 per cent. A spindle speed of 1800 rpm and a feed rate of 8 to 10 inches per minute are used in the roughing operation, and a spindle speed of 2645 rpm and a feed rate of 15 inches per minute are used for finishing.

Before numerically controlled milling can be performed, dimensional data defining part geometry and information concerned with the metal-cutting operation such as the cutter size, feed rates, and sequence of cuts must be assembled and processed. A manuscript is used as the

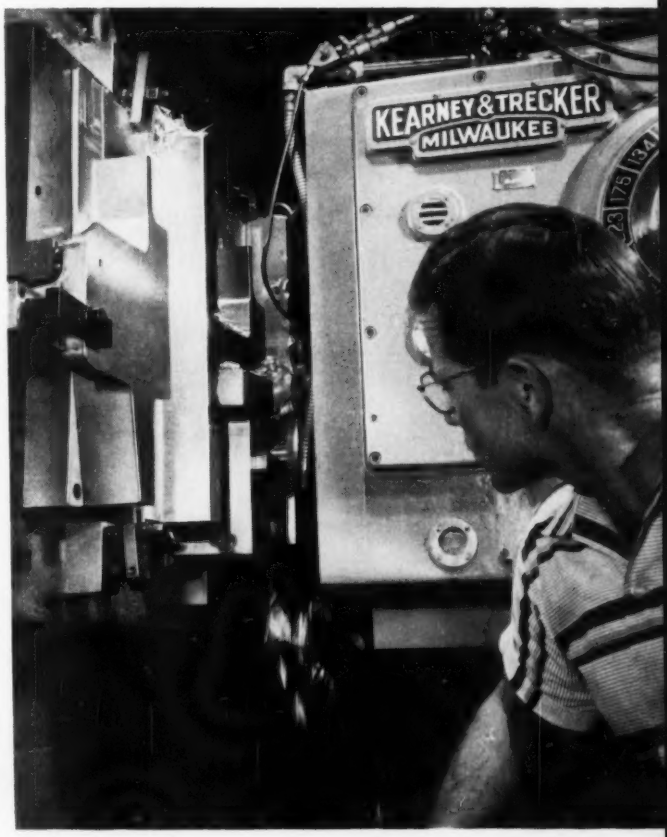


Fig. 3. An aluminum forging for a fitting of a Boeing B-52G missile-platform bomber being milled on a numerically controlled profile-milling machine.

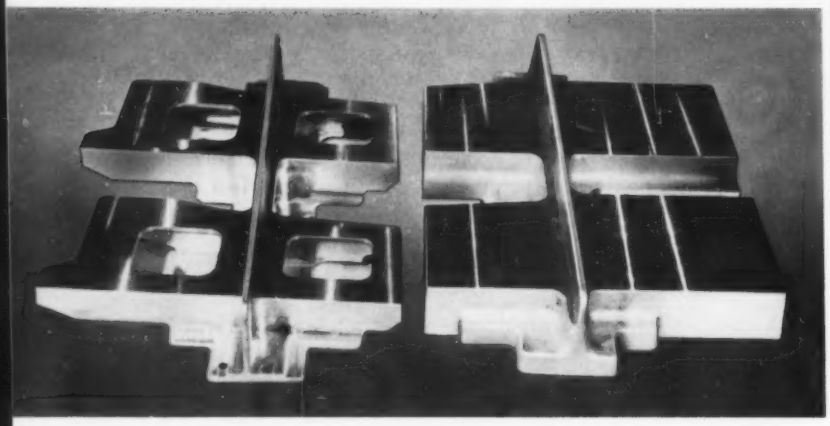


Fig. 4. Machining time is reduced 35 per cent and over 1000 hours of tooling time were saved in the production of these aluminum aircraft fittings.

Table 3. Time Expended in Tooling for and Machining the Forged-Aluminum Aircraft Fittings Shown in Fig. 4.

Machining Method	Conventional	Numerical Control
Tooling Time	(Hours)	(Hours)
Tool Design	390	279
Tool Fabrication	3083	2166
Production Planning	16	35
Data Processing	0	8
Machine Setup	6	3
Total	3495	2491
Machining Time Per Part	11	7

means for organizing this data for input to a computer. When the manuscript is correctly filled out, all the information is arranged in proper sequence for the computer. At Boeing, IBM cards are then prepared from the manuscript by a key punch—a card for each line in the manuscript. At this point the cards are checked for accuracy through the use of standard key-punch procedures.

The verified cards are then fed into an IBM 705 computer that interprets the data provided by them. This computer calculates cutter center offset, interpolates curved sections to provide intermediate points defining a continuous cutter path, resolves feed rate into required speeds of the individual machine slides, and translates the decimal input information into a binary-code form. The interpolation function performed by the computer establishes the required spacing of intermediate points on curved sections in accordance with the tolerence specified. In addition, this information is punched on control cards by the computer exactly as required by the Bendix machine-control unit, which is shown close-up in Fig. 5.

A card-to-tape converter is used to produce a punched plastic control tape containing the same information as the control cards. This tape is then mounted on a photoelectric reader in the machine-control unit. This unit automatically picks up information from the control tape and causes the milling machine to generate all of the motions that are necessary to the production of the required work-piece.

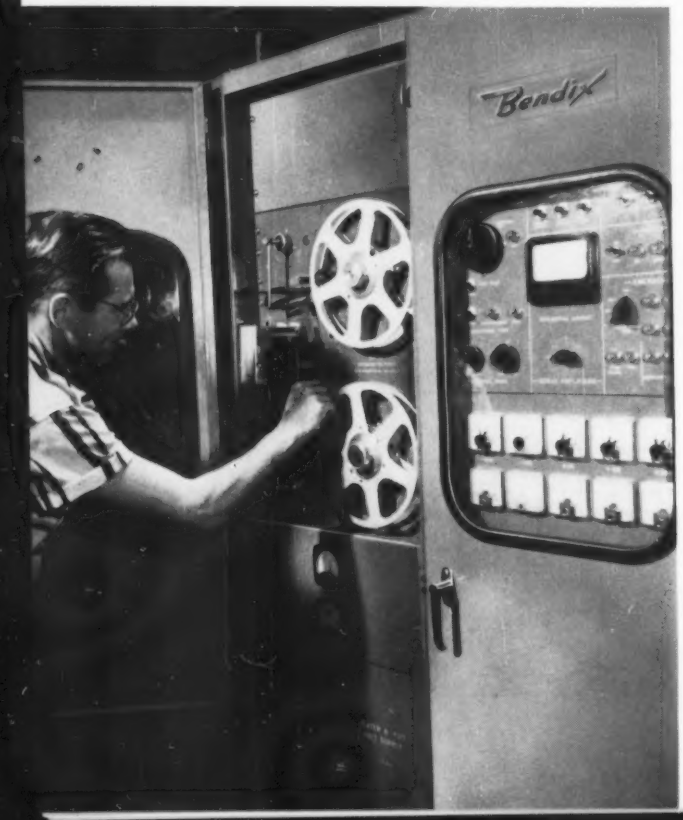


Fig. 5. Operator is adjusting the numerical-control unit for a profile-milling machine. Three such control units and machines are in use at Boeing's Wichita, Kan., plant.

High-Speed Machining with Disposable Inserts

C. S. CURRIE, JR.
Small Aircraft Engine Department
General Electric Co.
Lynn, Mass.

SAVINGS of more than $150,000 over a three-year period at General Electric's Everett, Mass., plant can be attributed to disposable (throw-away) carbide inserts. In addition, floor space in the grinding room and the tool-crib has been reduced substantially. The inserts were used on semi-automatic production equipment like vertical turret lathes and horizontal chucking machines.

Before adopting the new tooling concept brazed-tip type carbides were used, and it was the rule to base cutting speeds on the maximum tool life obtainable. Tool regrinding time and tool resetting time were important cost factors, so cutting speeds were held down deliberately, and the available horsepower of the machines was not fully utilized. What is more, the tip brazing produced characteristics that caused undesirable fluctuations in tool life. At present, the disposable inserts have completely eliminated regrinding, setup time has been greatly reduced, and tool life has been stabilized.

The disposable insert is a wafer of precision-ground carbide, nested and mechanically held in a carbon-steel holder. Once a cutting edge has worn, the insert can be indexed in its holder. Inserts are available with either positive or negative back rake. Each style offers the user certain advantages.

Positive back-rake inserts are freer cutting, so are better where the shape of the part does not permit the most rigid fixturing, or where thin sections have to be prevented from deflecting. Again, if the machine tool is underpowered, or the work material very soft, or a surface finish requirement has to be met, the positive back-rake insert is preferred.

Negative back-rake inserts, on the other hand, are less expensive, and can be inverted in their holders, thus offering twice the number of cutting edges as do their positive back-rake counterparts. They perform adequately on the majority of jobs which are encountered in the average machine shop.

Fig. 1. Without interrupting the machining cycle, the operator indexes one of the inserts. New cutting edge will repeat within an accuracy of 0.002 inch.

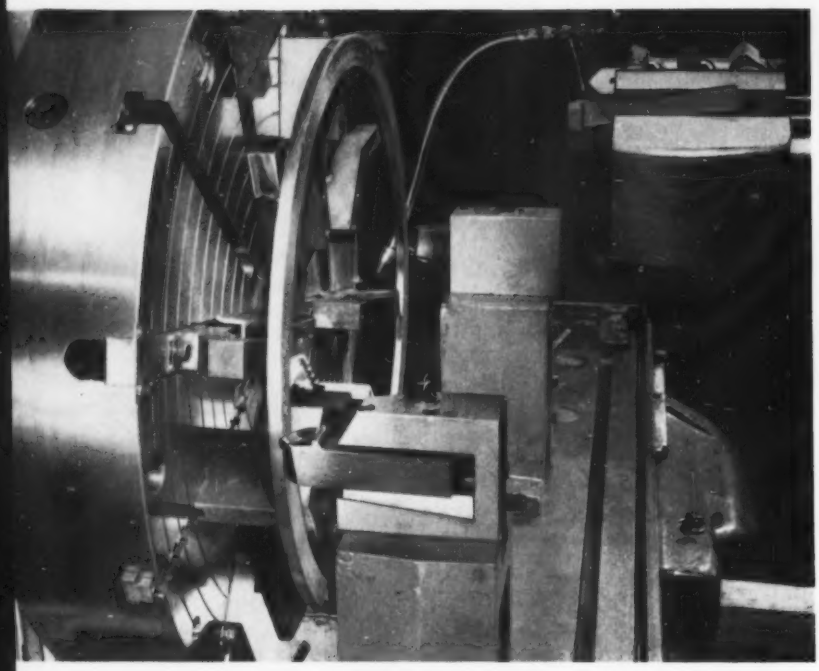


Fig. 2. All of the inserts used in this setup have negative back rake. Pinch type chuck grips the work without distorting it.

By converting from brazed single-point, lead-angle carbide tools to positive back-rake disposable inserts, the cutting speed for machining a 22-inch diameter, stainless-steel ring has been increased from 225 to 1000 sfpm (surface feet per minute). The machine, a vertical turret lathe, is completely tooled with these inserts. Except for the loading and unloading, the cycle is entirely automatic. There is no down time for indexing the inserts, as this is done during the machining cycle (see Fig. 1). It is interesting to note that because the ring is a high-production item and there are only four machines available, 50 per cent of the tool life is being sacrificed (as opposed to the principle earlier outlined) to machine at high speed.

One example of the results obtained by converting from the standard stock variety of brazed type carbide tools to negative back-rake inserts is the 20-inch diameter ring seen on the chucking machine in Fig. 2. The two tools on the cross-slide rough- and finish-face. Another two tools are supported from the turret of the machine, one a boring tool and one a chamfering tool. To grip the ring without distorting it, a pinch type chuck is used. The saving realized by this setup amounts to $1.25 per piece over the previous method.

Vibration, rather than heat, is an acute problem in high-speed machining. It can be minimized by using heavy-duty tool-holders having short shanks, rugged machines in good condition, and satisfactory fixturing practice.

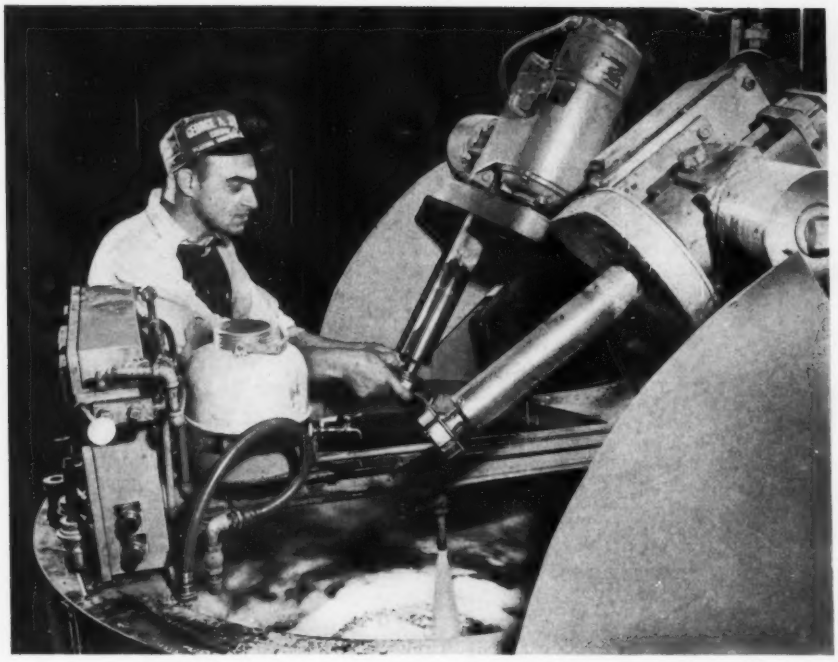
About 90 per cent of all disposable-insert applications can be made with standard catalogue items. The others require adaptation of existing inserts or special designs.

° ° °

Welding High-Speed Steel

To eliminate the necessity for returning broken high-speed-steel saw bands to the manufacturing plant for rewelding, the DoALL Co. has developed a new type of flash butt-welding machine. Carbon-steel saw-band welders leave hard particles in the weld, and then remove them by full annealing, producing a usable joint. This process is not feasible with high-speed-steel saw band because the proper annealing to remove this brittleness would result in a joint with too low a tensile strength, yield strength, hardness, and endurance limit.

The new saw-band welding machine eliminates the undesirable particles by upsetting. After the ends to be joined are heated by the electrical arc, they are forced together with great pressure and speed. In this operation, only the sound band material is joined. The overheated, brittle portions are squeezed out to each side of the band into the flash and removed with it. To assure long band life, the weld is only reheated for a short stress-relieving and not given a full annealing as is done on carbon-steel welders. The new welders are being installed in the company's local stores.



Here, parts are being removed from the raised spindles after machine deburring in a tank containing abrasive chips, soap solution, and water. In operation, both the tank and spindles are rotated.

Deburring by Machine Proves Economical

SPECIFICATIONS for several steel aircraft engine and tank transmission components produced by Hupp Aviation Division of Hupp Corporation, Chicago, Ill., require the removal of burrs and a slight rounding of the edges after machining. The parts, which include gears and jaw-clutch members, are being effectively and economically processed for these operations in the Mechamatic machine seen in the illustration. This equipment is made by the Mecha Finish Corporation, Sturgis, Mich.

A work-piece is secured to the lower end of each of two spindles which can be pivoted upward for loading. Clamping is accomplished by jaws which are expanded in the bore of the part by air-operated tapered cams. The spindles are then swung downward to a vertical position, submerging the work-piece in synthetic abrasive chips of various sizes.

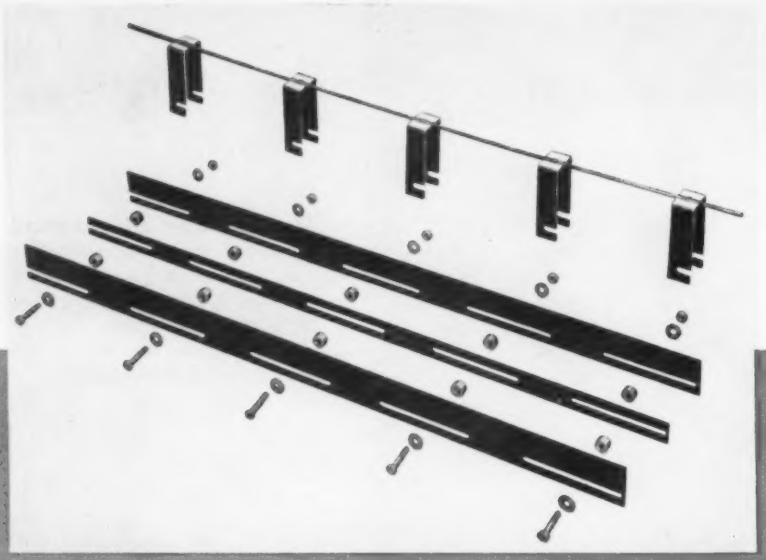
In operation, the spindles and the parts are rotated at 115 rpm as they pass through the abrasive chips, which are held in a tub rotating at 60 rpm. Water is fed into the tub in a small stream to wet the chips, and a heavy liquid soap is added slowly to improve the cutting action and to keep chips from glazing. As the excess water overflows through a cylindrical screen, the tub does not fill.

The time necessary to complete a work-piece can be varied and depends partly on the nature of the burrs and the degree of edge-rounding specified. The operating interval, which is predetermined, is set on a timing mechanism. At the completion of the cycle, the timer actuates controls that cause the two spindles to lift the work-pieces out of the abrasive and to stop rotating for both unloading and reloading operations. Deburring by means of this equipment is both faster and more uniform than by hand, which was the method formerly employed.

° ° °

Research on Cemented Borides for Tool Bits

The second phase of a research study of the potential use of boride composites for metal-cutting tools has been completed by the American Society of Tool Engineers. Results of the experiments, which were conducted at the Illinois Institute of Technology by the Armour Research Foundation under ASTE sponsorship, are contained in an illustrated, 61-page report entitled, "Cemented Boride Composites for Tool Bits." In laboratory tests, nickel-titanium diboride showed the greatest promise for use in cutting tools, though many combinations of borides and bonds were tried.



STANDARDIZATION INCREASES

Low-cost, off-the-shelf work-handling devices that can easily be adapted to part or process changes are making automation suitable for small plants as well as more economical for medium-size and large plants.

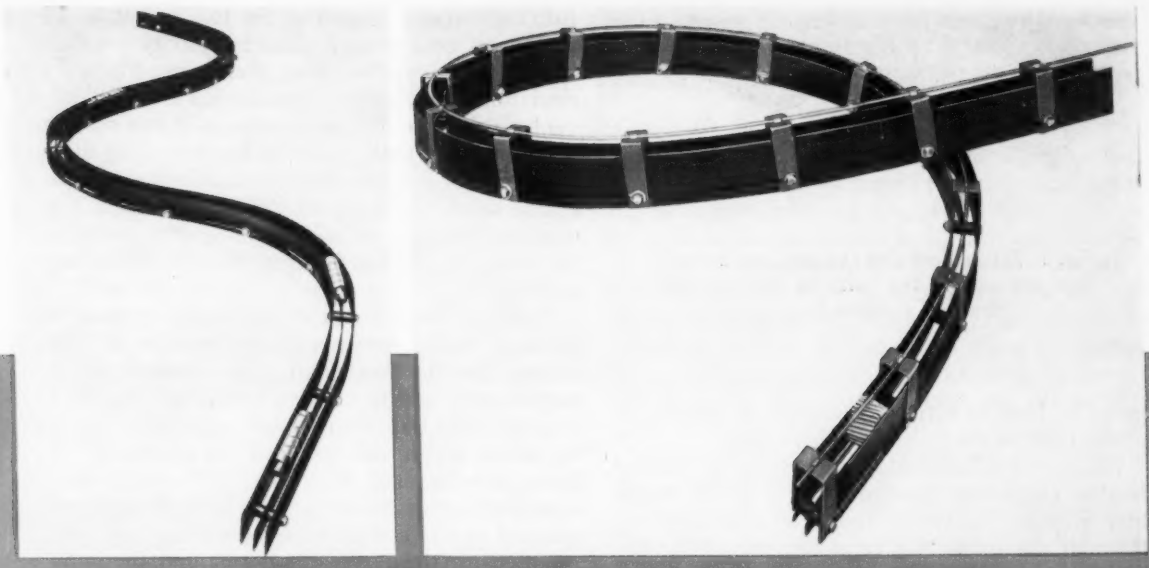
AMONG THE MISCONCEPTIONS that persist in management's consideration of the possible adoption of automation are the beliefs that it is necessary to automate a complete plant or process line, and that it is too expensive for small shops. To refute the first belief, there are many instances of highly successful "in-between automation," in which parts are automatically transferred between only two machines.

Obtaining maximum productive capacity from standard, automatic machine tools involves more than running them at top speed. Work flow to and from individual machines must be coordinated and controlled, and manual bulk-handling of the parts in process is an obvious impediment. Automatic work-handling is, in many cases, essential in order to keep pace with the high production rates possible on most modern machines.

Fully automatic parts-handling systems, while well suited to such tasks, have, until recently, required custom tailoring to part configurations and plant conditions, thus making the cost prohibitive to many manufacturers—especially those with small plants. Even where the volume of production justifies the high cost of such special designs and installations, the probability of system obsolescence due to changes in the part design or plant layout has discouraged capital investment for such purposes.

However, the cost of automation is rapidly decreasing with the development of standard parts-handling components that can easily be adapted to changes in the design of the part or its processing. One of the pioneers in this development has been the F. Jos. Lamb Co., Detroit, Mich. This company has recently made available eight low-cost, off-the-shelf parts-handling components which provide the four basic functions for coordinated and controlled parts movement:

1. Gravitational flow of the parts.
2. Control of the parts flow.
3. Elevation of the parts to take advantage of gravity.
4. Live storage of the parts.



FLEXIBILITY OF AUTOMATION

The design of each component provides maximum flexibility of installation and adaptability to various part configurations. Bolted construction of all units allows on-site assembly with only a few tools and no need for special skills. Installations can be varied, depending on the existing plant layout, with compact mountings on available floor space or in free area above the machines. Work-pieces can easily be routed around building obstructions such as support columns and ducting. This "taking to the air" approach for work flow is exemplified by a bearing manufacturer who recently doubled his production without adding a single foot of floor space.

For gravitational flow of the work-pieces, Lamb has developed "FabriFlex" patented chuting, which consists basically of blue-tempered, rolled-edge, spring-steel side and ride rails. The polished rails have a hardness of 46 to 48 Rockwell C. A uniform cross-section is maintained by means of spacers, and the flexible chuting is held together with standard bolts, nuts, and washers. An exploded view of a typical section of FabriFlex chuting is seen at the extreme left in the heading illustrations. For part flow through a corrosive atmosphere or magnetic field, the chuting components can be made of either nylon or stainless steel.

Previously, chuting of the required length and contour (to conform with the plant layout) was usually fabricated by the manufacturer before shipment to the user, thereby necessitating considerable engineering and drafting expense. Now, the FabriFlex chuting is shipped in long lengths or coils from which portions of any required length can be cut and secured to one another. Elongated openings are provided in the side and ride rails for easy bolted assembly on the job. The only engineering required is a simple cross-sectional drawing which determines the width of the side and ride rails, and the length of the spacers and bolts required.

Only four simple steps are necessary to connect two given points. First, the required length—varying from a few feet to several hundred feet or more, and following a direct or any irregular path required—is measured. Next, the side and ride rails are sheared to length. The third step consists of preassembling the chuting at floor level. Finally, the end terminals are secured to the points to be connected, and the lock-nuts are tightened. An open-end and a ratchet wrench are the only tools required. The inherent spring-steel property of conforming to a natural radius permits the chuting to conform with any plant layout, to be wrapped around building obstructions,

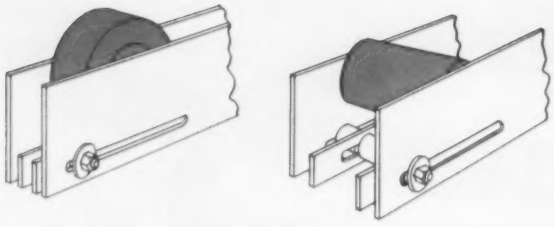


Fig. 1. Future part-size changes require only that the spacers and bolts be replaced with those of suitable lengths.

or to be bent to extreme contours, as illustrated at the right in the heading illustrations.

An important advantage of this type of chuting is that chips and foreign matter, which could clog regular, enclosed-channel chutes, can fall through the open, rail type bottoms. Also, the high polish on the side rails and the line contact of the ride rails with the work-pieces minimize friction. However, possibly the most important single advantage is its adaptability to future changes in the process or part design. All that is necessary for such contingencies is the addition or subtraction of spacers and the use of longer or shorter bolts. For example, Fig. 1 illustrates how the same chuting can be used for cylindrical parts of different diameters and lengths.

Versatility of the chuting also extends to parts that are not cylindrical or symmetrical. An arrangement for cylindrical parts having a stepped hub on one end is seen at the top in Fig. 2. To effectively convey such parts by gravity, support must be provided on both diameters. The only deviation in the chute cross-section is in the off-center ride rails. Where a wider ride-rail section is required—as with the roller bearing cones illustrated at the bottom—several standard ride rails can be sandwiched together. With this setup, the cones roll on their unfinished flanges, and no contact is made with the Superfinished roller bearing surface.

Narrow, flanged parts sometimes present a problem with gravity chuting because of the chance that the flanges on adjacent work-pieces may overlap and jam. If such parts are retained only by their hub thrust faces, any variation in the chute width will increase the possibility of flange overlapping. However, with the FabriFlex construction shown in Fig. 3, the flanges are retained at the critical areas—both top and bottom. Because the part is totally retained, the same chute could be used for vertical rolling or horizontal sliding.

Two methods of feeding stemmed parts by gravity flow are illustrated at the upper left in Fig. 4. The undersides of the rivet heads slide along the top edges of the side rails, while the sub-assemblies slide along the top of the ride rails. Good wear resistance is afforded by the tempered spring-steel rails to abrasive parts such as castings. At the upper right is shown a multiple ride-rail arrangement which is desirable for press operations where the lubricant or drawing compound becomes sticky and is deposited on the discharge chuting. The open-bottom FabriFlex construction permits a maximum of drop out.

For parts having protruding lugs, such as the ones seen at the lower left, the ride rails can be furnished oversize (higher, but of the same thickness). This arrangement permits the lugs to fall between the ride rails, with the parts sliding by gravity on flat surfaces. The geometry of some parts affords neither good rolling nor sliding characteristics. Such a part is shown at the lower right in Fig. 4. With a standard open-top chute, the parts would tend to climb over each other and clog. However, by extending the height of the side rails and providing a top rail, the part is enclosed. The distance between the top and ride rails is made equal to the distance across the "flats" of the parts.

Parts that have gear teeth or splines on their peripheries are also subject to interlocking in the

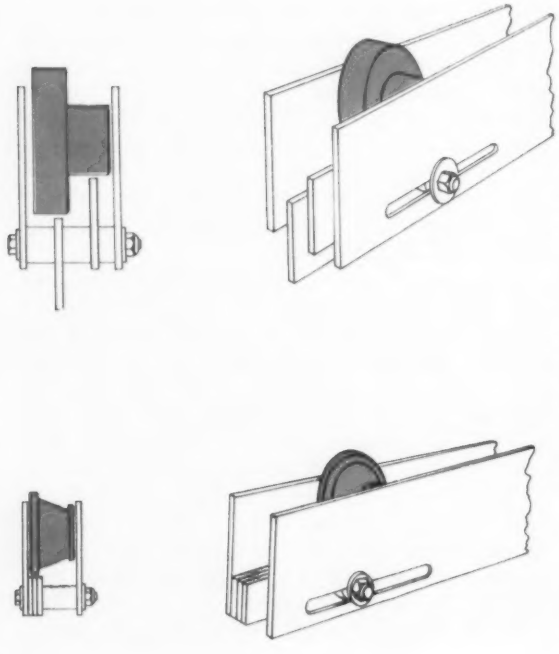


Fig. 2. Two of the many variations possible in ride-rail arrangements to accommodate different parts. Multiple ride rails are used to provide a wide section.

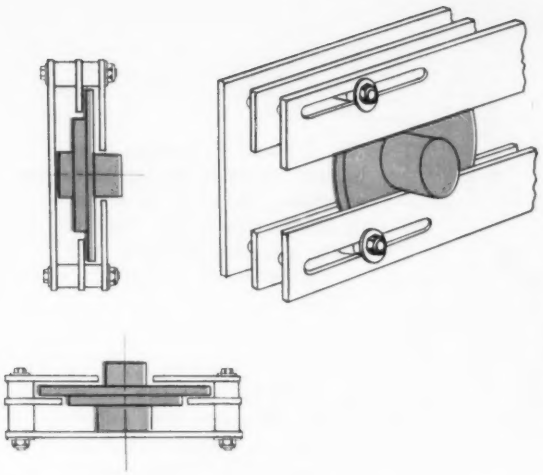
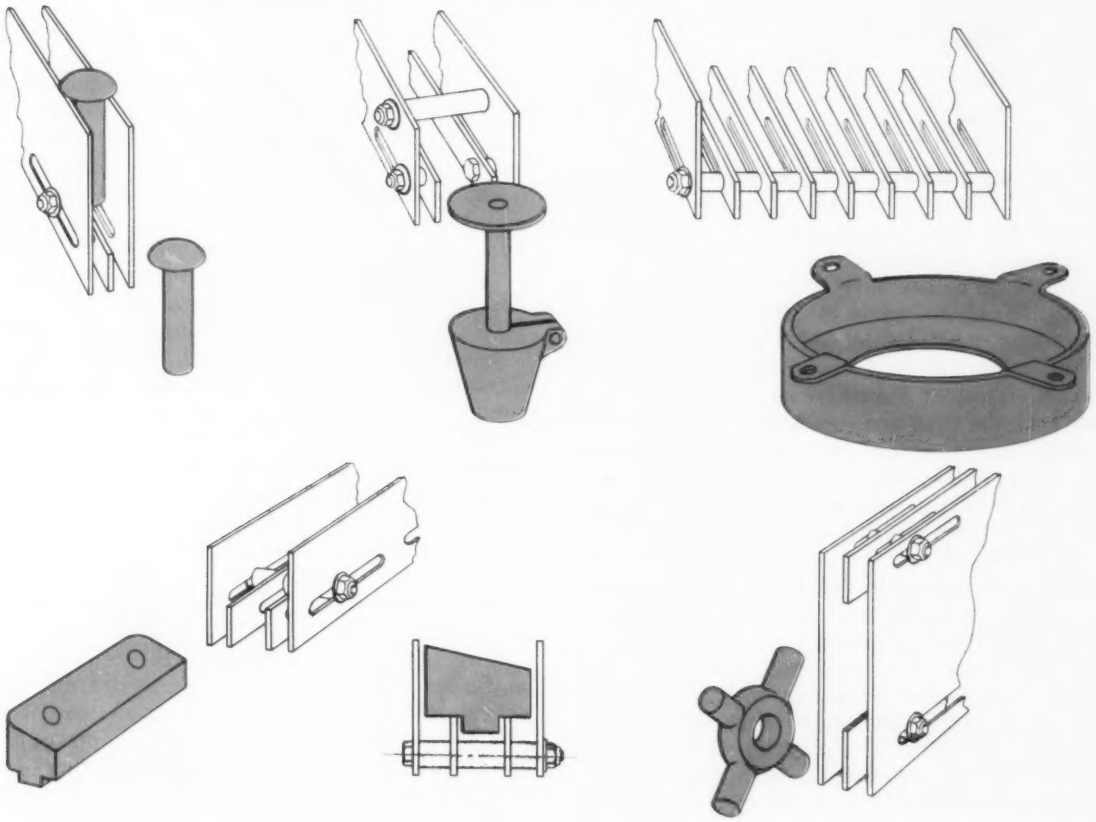


Fig. 3. Narrow, flanged parts are totally retained with this chuting arrangement, which can be mounted vertically for rolling or horizontally for sliding.

chutes, which would interfere with gravity flow. This can be overcome in several ways. For example, as illustrated at the top in Fig. 5, the parts can be placed alternately in a chute provided with top and bottom rail dividers to prevent interlocking or meshing of the splines or teeth. Another solution, seen at the bottom, would be to provide counterweighted stops in the standard FabriFlex chuting to prevent the parts from coming in contact with each other. Assuming there are parts in Stations 1 and 2, the next part coming down the chute would pivot the counterbalance at Station 3 and come to rest against the heel of the counterbalance at Station 2. This process is repeated as other parts stack up along the chute. When the part at Station 1 is removed, the counterbalance at this station pivots and allows the next part to roll from Station 2 to 1. This sets off a chain reaction, and all of the succeeding parts are advanced one station.

For low-production, short-run operations, it is sometimes necessary to supply several different size or shape parts to the same machine. This can be accomplished by providing multiple-chute assemblies, with the several chutes side by side, or one or more above the others. Common side rails can be utilized for two or more chutes. If the

Fig. 4. Various chuting arrangements for differently shaped parts. For part seen at lower left, ride rails are so spaced to accommodate lugs.



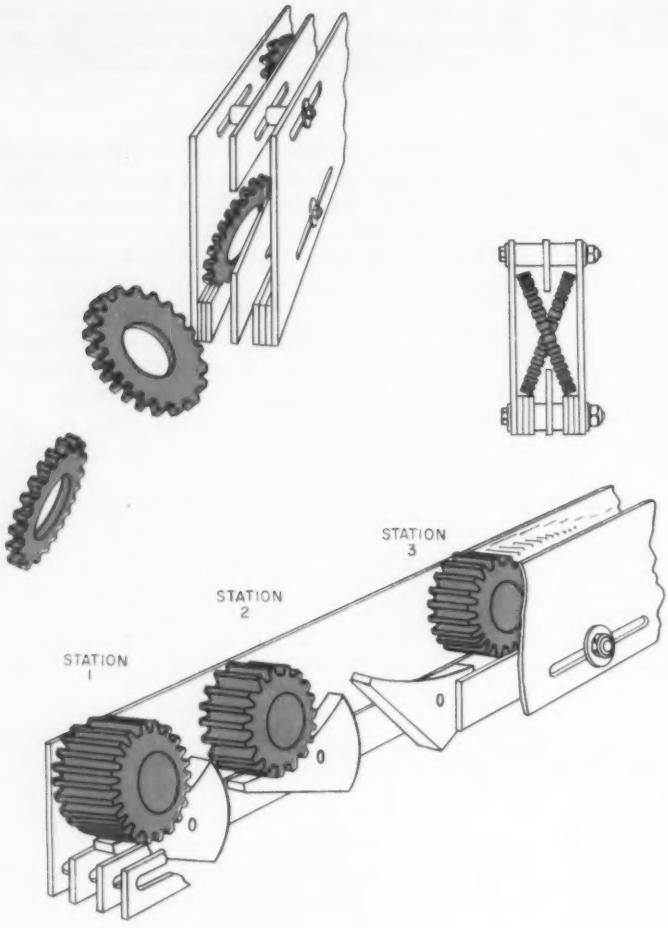
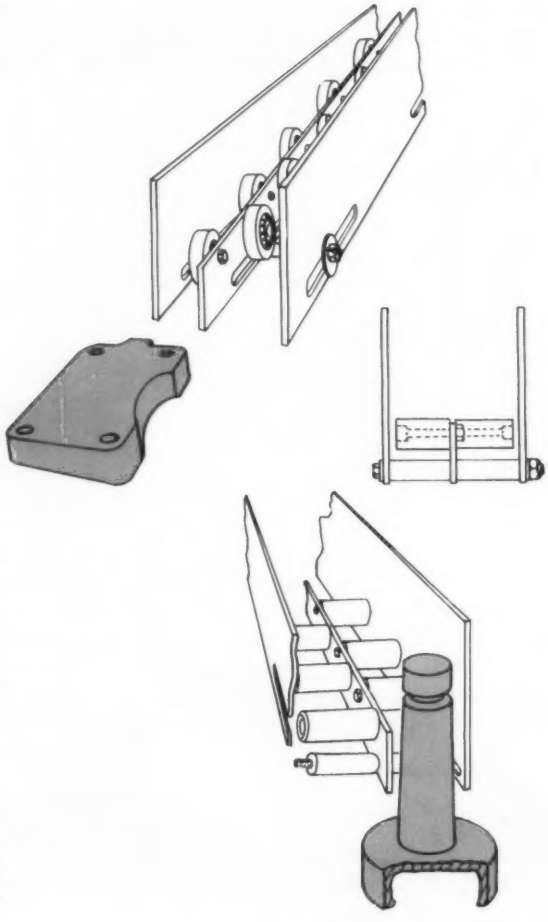


Fig. 5. (Left) To prevent interlocking of parts having teeth or splines, they can be placed in chute alternately (top) or chute can be provided with counterweight (bottom).

Fig. 6. (Below) For flat, light, or delicate parts, ride rail of chuting is equipped with roller bearings (top). Wider, nylon- or steel-tubing rollers are employed for the part at bottom.



chutes are manually fed, it is only necessary for the operator to place the parts in the proper chute. For automatic operation, a switch assembly can be provided at the chute ends.

Some machines have an oscillating infeed or discharge chute, while others have chute terminals that must be moved (together with the work-holding fixture) toward the tool as the tool wears. Standard FabriFlex chuting can be used for both the rigid and oscillating sections in such cases. Up to the pivot point, the lock-nuts would be tightened securely on the rigid section of chuting. On the oscillating or flexible section (from the pivot point), the lock-nuts would be backed off slightly to permit the spacers and bolts to slide along the elongated slots in the rails.

Gravity conveyance of relatively flat, light, or delicate parts often presents a problem. To make the parts slide, a steeper chute pitch must generally be provided. However, this subjects delicate parts such as pistons to damage when they contact each other at the higher velocities produced. This can be overcome by using FabriFlex chuting having the same basic cross-section, but

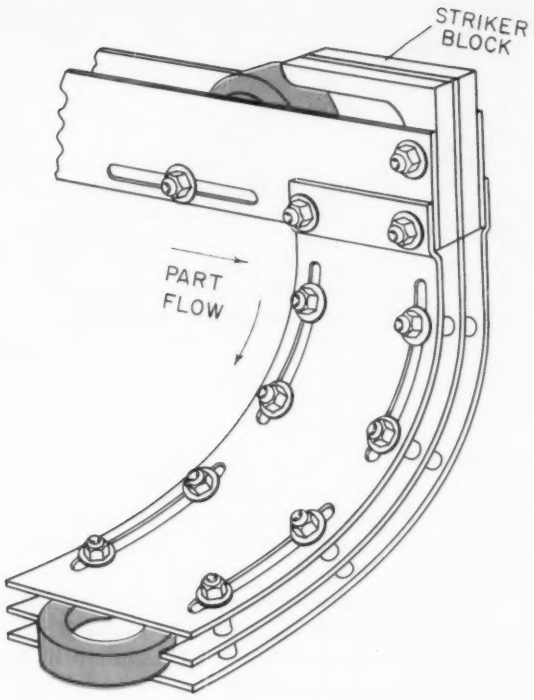


Fig. 7. Chuting arrangement for changing parts from rolling to sliding position. As the rolling parts contact the striker block they fall into a totally enclosed chute.

with roller bearings individually bolted to the center ride rail to retain full flexibility, as illustrated at the top in Fig. 6. As the parts slide along the chute, the inertia of the roller bearings at rest must be overcome. This reduces the velocity of the work-pieces, and lessens the chances of damage when they contact each other. For parts not having a flat surface on which to slide (such as the one seen at the lower right), full-width, nylon- or steel-tubing rollers are used.

Less pitch is usually required for gravity flow if the parts are rolling. However, some machine fixtures require that the parts be in a sliding position. Fig. 7 illustrates how the parts can be changed from rolling to sliding positions. As the parts roll down the open-top chute, they contact a striker block. At this point, the ride rail would be cut short to permit the parts to drop into sliding position in a totally enclosed chute that is lap-bolted to the upper chute. A similar but inverted arrangement can be used to change the parts from a sliding to a rolling position.

Reorienting of non-symmetrical, cylindrical parts can be accomplished with the arrangement illustrated in Fig. 8. In this setup, the work-pieces are swung 180 degrees in a vertical plane so that they are delivered to the second machine with their flanges on the opposite side from that in which they were discharged from the first machine.

At certain locations in the gravity flow of parts, it may become necessary to maintain a minimum elevation for head clearance. This can be done by wrapping the chuting helically around a floor-mounted drum, or in a figure-eight pattern around vertical posts suspended from the ceiling. Either of these arrangements also provides a small bank of parts prior to the next operation. In dumping parts from a chute into a bulk-storage unit, the distance the parts drop would determine the amount of nicking. This can be reduced by winding the chuting in a helical path toward the bottom of the unit and removing the inner side rail from the wound portion of the chuting. Centrifugal force keeps the parts on the open-sided chute until they reach the bulk level, at which point they fall off the chute. As the level falls or rises, the distance through which the parts drop remains approximately the same.

Because of its unique, bolted construction, many auxiliary components can be readily attached to the FabriFlex chuting. Three such attachments are illustrated in Fig. 9. A standard safety guard rail can be provided over the open top of the chuting to prevent parts from being

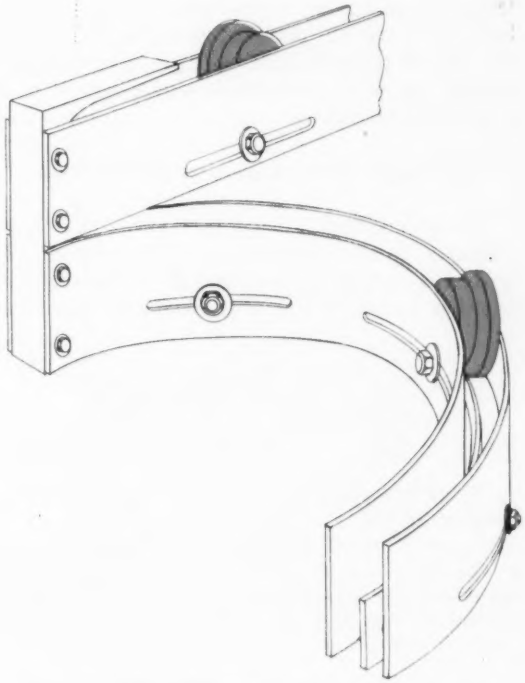


Fig. 8. Reorienting of parts from flange on left to flange on right is accomplished with this chuting setup. The work-pieces are rotated 180 degrees in a vertical plane.

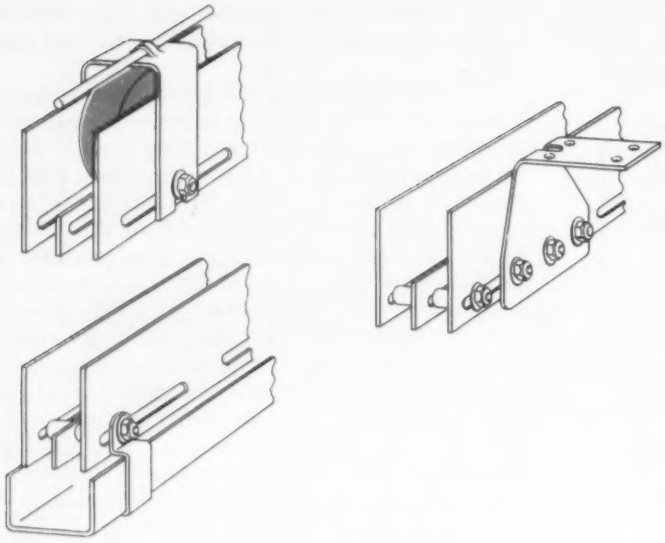


Fig. 9. Standard attachments for chuting include safety guard rails, chip-and-drip troughs, and brackets for mounting counters, switches, and escapement mechanisms.

forced out of, or being manually inserted in, the chuting. Chip-and-drip troughs are installed as required—for example, when the chuting passes over machines, operators, or aisles. Mounting brackets are supplied for attaching counters, switches, escapement mechanisms, and similar devices. Depending on the weight of the work-pieces, short sections of chuting, up to 8 feet in length require no intermediate supports. For longer sections or heavier parts, the chuting can be supported by adjustable-height, floor-mounted stands, or from adjustable-length, turnbuckle type ceiling hangers.

Control of Parts Flow and Distribution

The second basic function necessary for coordinated parts movement in any automation system is control of the parts flow and distribution. For example, if two machines or operations are directly coupled by chuting (see Fig. 10), some means should be provided to signal machine *A* when parts begin to accumulate in the coupling chute between machines *A* and *B*. This can be done with a Lamb line-switch interlock, Fig. 11, which is of bolted construction to permit easy assembly without any chute alteration.

When a single work-piece rolls over the pivoted arms *C* on the interlock, the arms are not depressed sufficiently for any reaction. However, when the parts accumulate in the chute and more than one comes to rest on the arms, sufficient weight is provided to pivot the arms downward about an anti-friction bearing *D*. This raises the adjustable counterweight *E*, which actuates a standard limit switch *F*. The electrical signal produced by the switch can be used to illuminate a warning light, stop the parts flow, divert the parts, or indicate malfunction of machine *B* (Fig. 10).

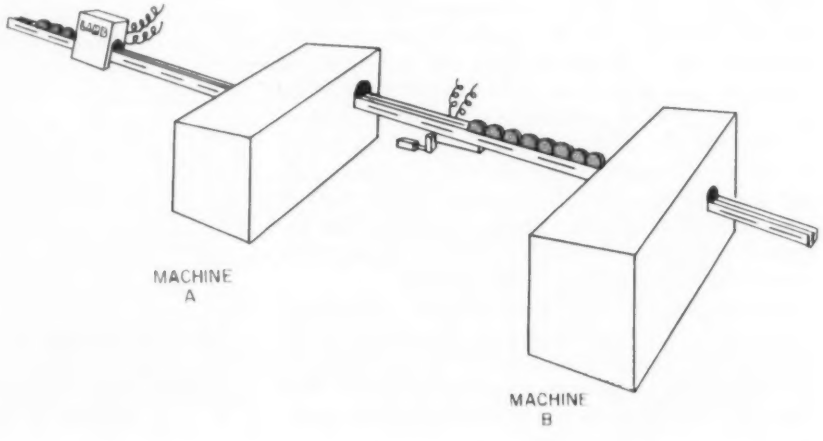


Fig. 10. When parts accumulate in chute connecting machines (A) and (B), the line-switch interlock signals the shot-bolt interlock to stop flow of parts to machine (A).

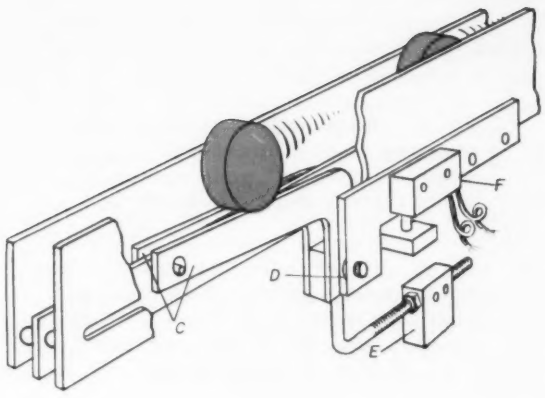


Fig. 11. When more than one work-piece is on the pivoting arms (C), the adjustable counterweight (E) is raised to actuate limit switch (F). The pivot point is bearing (D).

As soon as the switch is actuated, the flow of parts from machine *A* must be stopped. While this can be accomplished by using the electrical impulse from the switch to stop machine *A*, it might be a safety hazard. A better method is to stop the flow of parts into the machine. A Lamb shot-bolt interlock can be mounted on the incoming chute for this purpose. In this device, a standard solenoid normally keeps a nylon-tipped stop-bar in its uppermost position, thus permitting the parts to flow. However, when an electrical signal is received from the line switch, the solenoid is deenergized, and a spring moves the stop-bar downward in order to prevent the flow of parts.

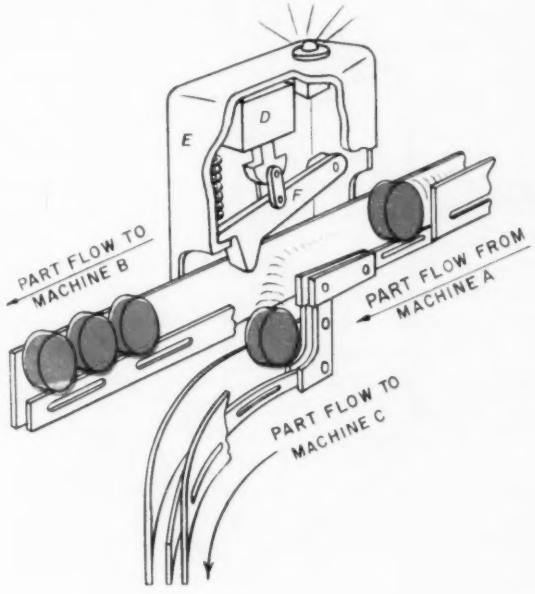
The optimum situation exists when all the machines in a line operate at maximum efficiency with the same productive rate. However, many times a single, high-production machine may supply parts to several lower-production machines. This condition can be handled by installing one or more Lamb shot-bolt distributors on the chuting between such operations. Fig. 12 illustrates such an installation for dividing the flow of parts from a machine *A* between machines *B* and *C*. Normally, the inertia of the parts rolling down the chute from machine *A* permits them to jump a gap in the ride rails and continue on to feed machine *B*. When an electrical signal is received from a limit switch mounted on the chute supplying machine *B* (indicating that this chute is filled with parts), solenoid *D* in shot-bolt *E* is deenergized to permit the spring-loaded, nylon-tipped stop-bar *F* to drop down. Succeeding parts rolling down the chute from machine *A* are deflected by the nylon tip into the chute supplying machine *C*. Distribution can be controlled either manually or automatically (by means of limit switches), and from two to five machines or operations can be fed from a single supply chute.

Fig. 12. An electrically controlled shot-bolt distributor permits the feeding of parts—as they flow from machine (A)—to either machine (B) or machine (C).

Elevation of Work-Pieces

The third important element necessary for successful automation is means of elevating the parts to permit gravity flow. On many machines, the work-pieces are discharged at a low height, and it is necessary to elevate them to take advantage of gravity for further flow. The Lamb single-lift elevator, Fig. 13, consists of five basic components: a standard motor and speed-reducer drive assembly *A*, lift assembly *B*, clutch *C*, guide members *D*, and terminals *E*. Up to 5000 parts per hour, in a single-line part flow, can be handled on this elevator.

Lift assembly *B* is a standard cotter-pin type of roller chain with extended pins and hardened, part-lift rollers. Lift pins and rollers can be added or removed to suit future production needs. Ball-seat clutch *C* prevents damage to the elevator and parts by maintaining a uniform torque, backing up the chain slightly, and stopping the operation in case of jamming. When the jam is cleared, the clutch is automatically reset. Guide members *D* are made of blue-tempered and polished spring steel, with bolted construction. A uniform cross-section, which can be altered to



suit various part sizes, is maintained by the use of spacers. Input and discharge terminals *E* are designed to permit the easy assembly of Fabri-Flex chuting without alterations, and the height for both entrance and exit can be varied to suit the needs.

In many instances, parts supplied to the elevator from a single high-production machine must be elevated and distributed to several slower production machines. For such installations, elevators are available for distribution to from two to five machines. With a fixed-height distributing head, the pitch of the feed chutes may vary; this can cause difficulty in feeding if too low, or damage to the parts if too high. However, a constant pitch can be maintained by varying the height of the discharge terminals.

By extending the part-lift pins and rollers on both sides of the chain, and adding another "sandwich" of part guides, a single-lift elevator is converted into a dual-lift unit, Fig. 14. One

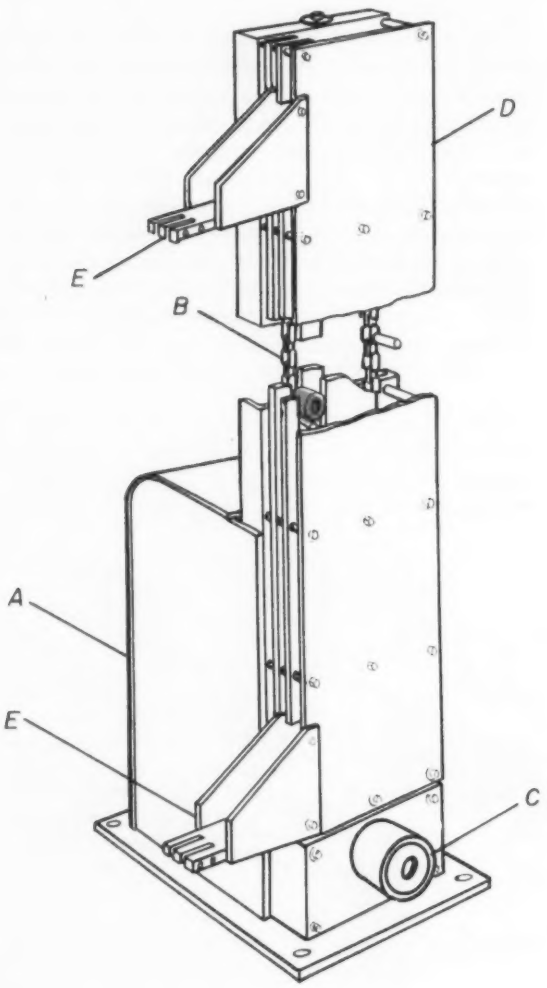
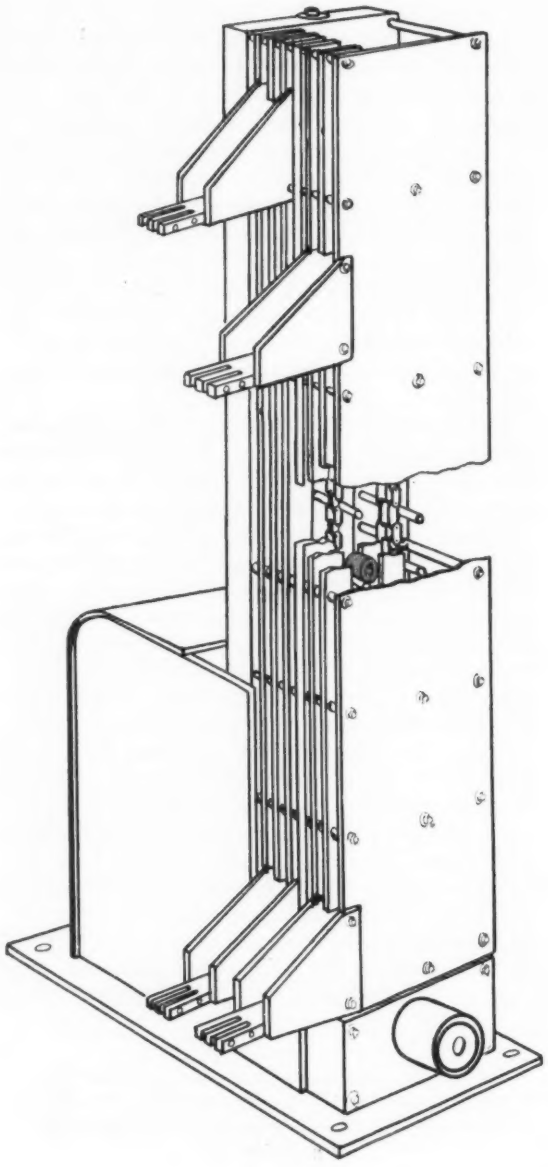


Fig. 13. (Below, left) Single-lift elevator consisting of drive assembly (A), lift assembly (B), clutch (C), guide members (D), and entrance and exit terminals (E).

Fig. 14. (Below, right) Dual-lift unit can be made from single-lift elevator, Fig. 13, by extending pins and rollers, and adding another set of part guides.



application for dual-lift elevators is the admission of parts at a low height from one machine, their elevation by means of its front lift for feeding to a second machine, their acceptance of parts from this machine, and their elevation by means of its rear lift for feeding to a third machine.

Another application consists of lifting different parts from two machines independently, and feeding them to two more machines. Either the front or rear, or both lifts, can have distributing heads mounted at various heights. In some cases it may be desirable to bypass a certain percentage or all of the parts being elevated for feeding to a second machine, if the second machine is overloaded or down for any reason. By connecting the front and rear lifts with a chuting bypass, some of the parts can be diverted directly to the third machine.

Production analyses have proved that when parts being produced on one group of machines must be fed to another, higher efficiency can be obtained by blending and redistributing the parts than by transferring them directly. Direct coupling of the machines may lead to more production interruptions. With a multiple-input elevator-distributor, all of the parts from the first group of machines are blended within the elevator and then metered out, as required, to the second group.

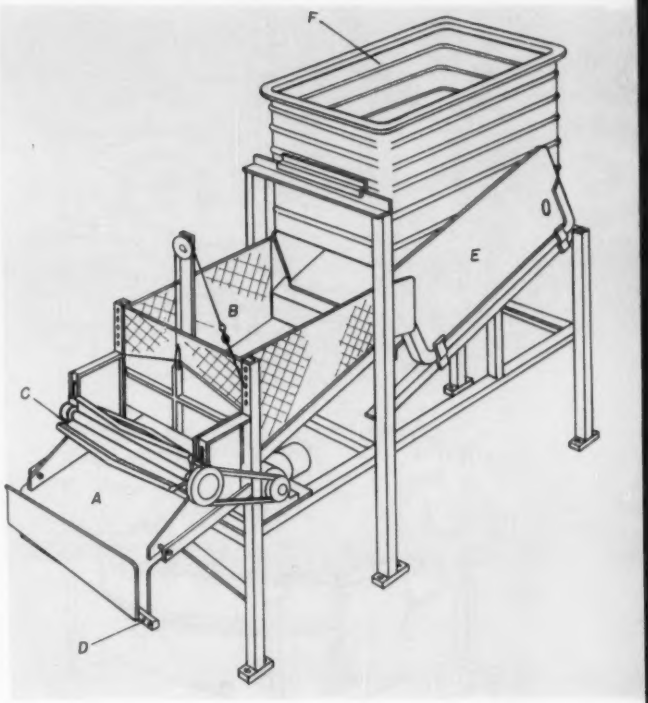


Fig. 15. Bulk-storage, oriented feeding unit has a vibrating shaker plate (A) to cause parts to flow from hopper (B) under restrictor (C).

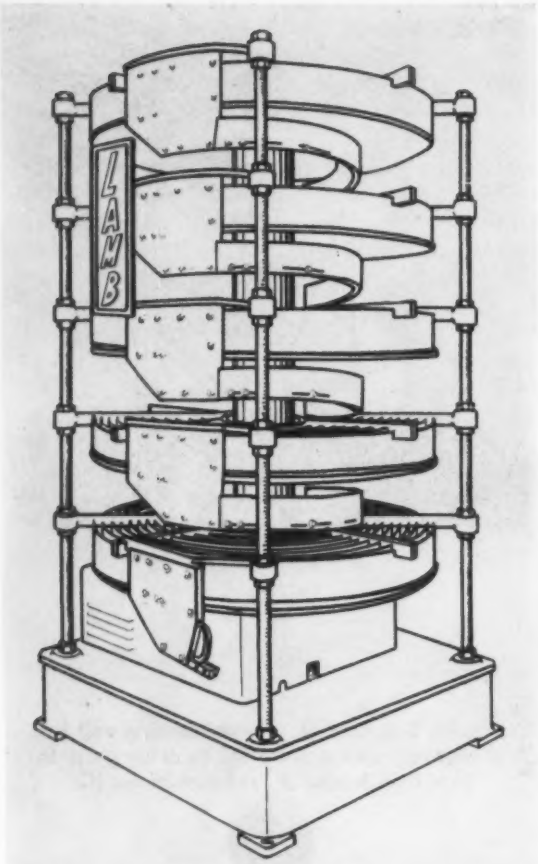
Storage of Parts Between Operations

The fourth and final element of an integrated automation system is provision for storing or banking the parts between operations. Prior to automation, skid bins, pans, or boxes were provided to bank the parts manually between operations. Temporary storage is necessary between machines having unbalanced production rates, or to take care of instances when either the preceding or succeeding machines are down for tool changes, wheel dressing, size adjustments, maintenance, or repairs.

An important consideration in setting up facilities is the quantity of parts to be stored. This can usually be determined by analyzing the production rates, and the times required for tool setting or changing. Two storage methods, bulk or oriented, are available, with the choice depending on the amount of abuse the parts can bear without impairing their quality. However, if the parts are to be stored in bulk, an orienting device is usually required to permit continued gravity flow.

A Lamb bulk-storage, oriented feeding unit is seen in Fig. 15. This unit accepts cylindrical parts in bulk or from a chute, and feeds them in an oriented position to chuting for movement to subsequent elevating, machining, or processing operations. A vibrating shaker plate *A* causes the parts to move from hopper *B* beneath a rotary restrictor *C*. This restrictor is adjusted to pass parts only when they are in a sliding position on the shaker plate. Sliding parts "waterfall" over the front edge of the shaker plate, and are reoriented into a rolling position to flow along chuting attached to terminal *D*.

Ordinarily, the parts are dropped directly into hopper *B* from a chute. However, if they have to be transported from another operation in a remote section of the plant, an integral support stand *E* is provided to hold a stock bin *F*. The bottom of the bin is hinged, so that when it is placed on the stand, the parts slide into the hopper. Another possible combination would be to attach an elevator to the bulk-storage, oriented feeding unit, with the elevator powered by the unit's drive motor. This arrangement would be used where additional height is required, while maintaining the orienting mechanism at an easily accessible height. Also, savings in floor area can be realized by arranging the storage and feeding units in double tiers, for storing the same part after two different operations, or two different parts individually.



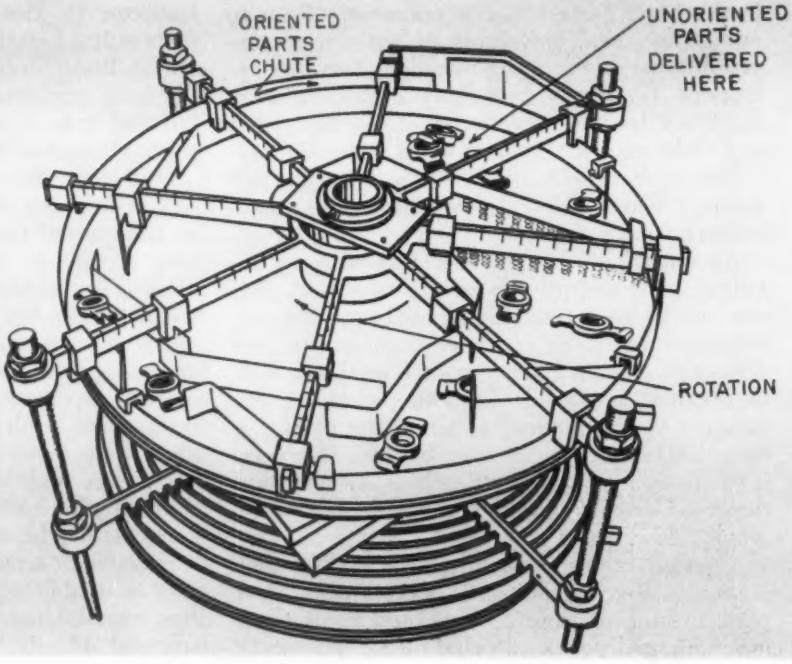
In cases where the parts may be damaged by impact with each other during bulk storage, some means of oriented storage is required. Spiral storage devices, such as the Lamb unit seen in Fig. 16, provide maximum storage capacity for a given floor area. The units consist essentially of a base, an adjustable-speed, motor-driven center column (mounted on anti-friction bearings), and from one to five rotary tiers. Depending on the size of the work-pieces, up to 30,000 parts can be stored in a single unit. Rolling cylindrical or sliding non-cylindrical parts are accepted, and both the orientation and sequence of parts are maintained from input to discharge terminals.

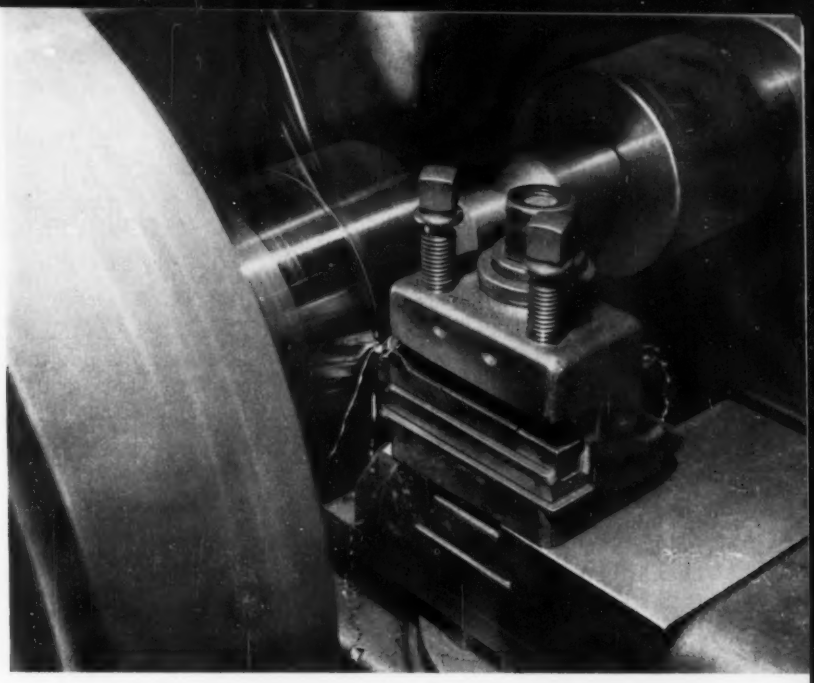
Each rotary tier consists of a continuous, spiral-shaped rack constructed of blue-tempered and polished spring steel. Incoming parts are delivered to the hub of the rotating tier, and are automatically carried to its outer edge for discharge into a chute or transfer (by means of a helically wound chute) to the hub of the next lower tier. All tiers can thus be used to store the same parts, or different parts can be stored on separate tiers simultaneously.

Still another variation is to have the parts delivered to the top tier unoriented. For example, Fig. 17 shows the orienting top tier of one spiral storage unit. A series of deflectors are provided on and above the rotary plate to orient and divert the parts to the outer edge of the plate. From here, the parts slide down a chute to the oriented storage rack directly below.

Fig. 16. (Above) Spiral type, oriented storage unit prevents parts from being damaged by impact with each other. Flow of parts is from center outward.

Fig. 17. (Right) Top tier of this spiral storage unit is equipped with a series of deflectors to orient and divert the parts to outer edge of plate for oriented storage in the lower tiers.





Tests show that it may be practical to eliminate all but finish-grinding operations by machining steel bearing races—60 to 63 Rockwell C—with cemented-oxide tools.

HARDENED BEARING RACES MACHINED WITH CEMENTED-OXIDE TOOLS

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DEVELOPMENT of economical methods and tooling for the production machining of hardened bearing races—as a replacement for all but finish-grinding operations—was the objective of extensive tests carried out by the Metallurgical Products Department of the General Electric Co. It was found that cemented oxides could be used successfully for machining SAE 52100 steel bearing races falling within a hardness range of 60 to 63 Rockwell C.

Description of Tests

A preliminary laboratory test was conducted to determine the most suitable machining practice for steels in the 51 to 57 Rockwell C range. Results of this test showed that cemented oxides having a tool character of −10, −10, 5, 5, 15, 60 (with 0.005- to 0.008-inch honed edges) exhibited optimum tool life at a cutting speed of 600 to 800 fpm (feet per minute), a feed of 0.0038 ipr (inches per revolution), and a 0.015-inch depth of cut. (Tool-character sequence is an American Standard. It designates, respectively, back-rake angle, side-rake angle, end-relief angle, side-relief angle, end cutting-edge angle, and side cutting-edge angle.) This information was used as the starting point for turning, boring, and facing the bearing races, which measured 4 inches wide and 7 inches in diameter, with a 6-inch diameter bore.

For turning the outside diameter the races were mounted on an arbor. During the boring and facing operations the races were chucked on their periphery. About 1 inch was allowed between the race and the chuck face to minimize the danger of accidental contact with the boring bar after completion of the cut.

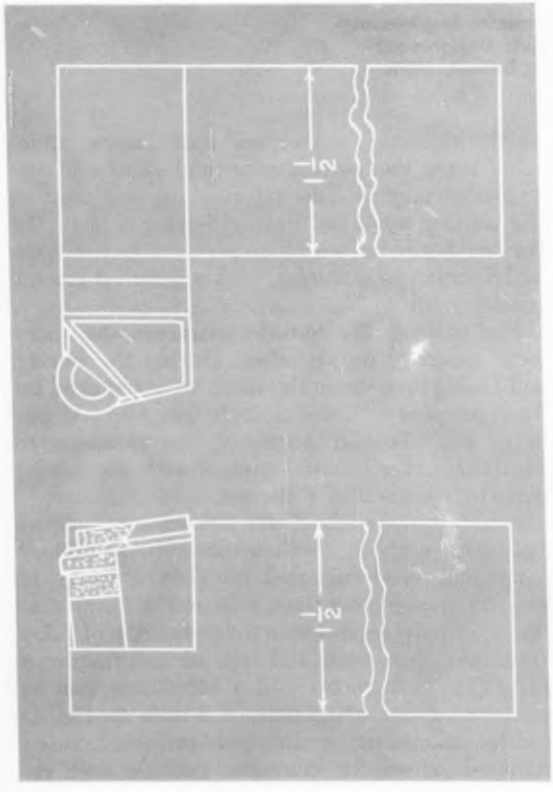
Tests were carried out on a 20-inch engine lathe equipped with a variable-speed drive. Other equipment used included an electric timer to record actual cutting time; a Bausch & Lomb machinist's microscope with a magnification of 7.5× to observe flank wear and type of tool failure; a Type QA Profilometer and a Mototrace unit to measure surface roughness; a 6-inch Ex-Cell-O grinder mounting a 220-grit resinoid-bonded diamond wheel for cemented-carbide and ce-

mented-oxide inserts; and a silicon-carbide hone.

Tool materials initially used were Grades 330, 905, and 907 cemented carbide, and Grade 0-30 cemented oxide in the following insert sizes: 1/2 inch square by 3/16 inch thick, 3/8 inch diameter by 3/16 inch thick, and 1/4 inch thick by 3/8 inch wide by 3/4 inch long. The disposable inserts were held in CSBR-85, CRAR-12, and CRAL-12 mechanical holders having a negative 5-degree back rake and a negative 5-degree side rake. The rectangular insert was held in a special mechanical holder with a 1-inch square shank and having neutral rake angles and 15-degree side and end cutting-edge angles. Special tool geometries were ground on inserts used in this holder. For boring operations, the CRAL-12 mechanical holder was brazed to the end of a 1 1/2-inch square bar, Fig. 1.

The tool character used at the start of the main test series was the same as that used during the preliminary test (−10, −10, 5, 5, 15, 60, with a honed edge). This was varied throughout the test by changing the side rake, back rake, side cutting-edge angle, and nose radius. Tool life was determined under the following conditions:

1. Speed and feed combinations were selected to provide a work-coverage rate of at least 32 square inches per minute on the periphery, and at least 16 square inches per minute in the bore.



2. Depth of cut was varied to yield different rates of stock removal.

3. Surface finish was to be held below 80 micro-inches A.A. (arithmetical average).

Results Obtained from Tests

In the first stages of the test series, cemented-carbide tools were run at a speed of 100 fpm, a feed of 0.005 ipr, and a cut depth ranging from 0.020 to 0.055 inch, but with little success in obtaining satisfactory tool life. (Tool life had ranged from 55 seconds to 14 minutes with chipping, flaking, and cratering of the insert.) Since the results of this speed and feed combination did not approach the conditions or tool-life criterion required, further testing of carbides was discontinued.

Turning tests were then made using cemented-oxide cutting tools. Longer and more consistent tool life was obtained using a rectangular insert (1/4 by 3/8 by 3/4 inch held in the special mechanical holder) ground to produce a tool character of 0, 0, 5, 5, 15, 60, 11/32. A negative 30- to 35-degree land was ground, as shown in Fig. 2. In addition, a 3/8-inch diameter insert, ground as shown in Fig. 3, was used in a CRAR-12 holder (heading illustration) with satisfactory results.

Boring the bearing race to a 6-inch inside diameter was the subject of the next group of tests. Superior results were found when using the same round cemented-oxide insert as shown in Fig. 3. The insert was supported in a CRAL-12 holder which, in turn, was brazed to the end of a 1 1/2-inch-square bar (Fig. 1). Using a constant feed of 0.005 ipr and a constant depth of cut of 0.015 inch, the speed was varied from 400 to 600 fpm with the tool located on the work center line. Under these conditions tool life varied from 13 to 63 minutes. When facing cuts were taken across the bearing races, satisfactory results were obtained using similar tool characters.

Throughout the testing procedure, tool life generally ranged from good to exceptional. However, chipping and flaking were a problem in some instances. They usually occurred at the top of the insert and at the depth-of-cut line. In many cases this was neither detrimental to the finish nor caused a loss in size of the races. The only noticeable effect was in the formation of the chip and in the additional heat generated due to the irregularity of the cutting edge.

Finishes obtained on almost all of the surfaces were well within the specified limit of 80 micro-inches A.A. In the few cases where surface finish

Fig. 1. For boring operations on a hardened-steel bearing race, a CRAL-12 mechanical holder was brazed to a 1 1/2-inch square bar. Insert is shown in Fig. 3.

did exceed this limit, tool life had gone well beyond the range expected. It was observed that the finish quality would decrease progressively as tool life increased. When checking the machined surface after the first pass, the finish was found to range from 10 to 20 micro-inches A.A.

For machining these hardened-steel bearing races, honing of the insert was found to be detrimental to good tool life. When honed edges were used on this material, pressure built up at the cutting edge, thereby developing increased frictional heat and leading to premature tool failure.

After test-machining the outside diameter of one bearing race to a 1/8-inch wall thickness, a section of the race was removed and submitted for a laboratory check. A photomicrograph (600×) of the turned area revealed no abnormal surface damage. Eight Knoop hardness tests were made at different depths. They revealed two things: First, the annealed layer caused by machining was less than 0.001 inch deep; and second, there was no measurable work-hardening.

Conclusions and Recommendations

Upon reviewing the test results it may be definitely concluded that cemented-oxide tools can be successfully utilized for machining SAE 52100 steel bearing races that have been hardened from 60 to 63 Rockwell C. Many of the chipping and flaking difficulties encountered can be attributed to the lathe used for conducting the tests. It was not a new machine, having been used constantly in the past few years for a variety of tests. As a result, the carriage, gears, and lead-screw were worn. Had a newer lathe been used, better finishes and longer tool life might have resulted.

One other cause of flaking on top of the insert and at the depth-of-cut line was the razor-sharp edge encountered on entering the cut. This edge occurred when the chamfer on the races was cut away after the first three or four passes. During production-turning of individual races, this difficulty will not be present and additional tool life can be expected.

As an initial approach to the problem of turning, boring, or facing this hardened material, it is recommended that a 3/8-inch diameter cemented-oxide insert—such as that shown in Fig. 3—be used. For turning, it is advisable to use a feed of 0.005 ipr, a speed of 600 fpm, and a depth of cut ranging from 0.015 to 0.030 inch. Under these conditions, a finish well under 80 micro-inches A.A. can be obtained. Facing cuts can be taken in the same way.

When boring, conditions similar to those for turning can be employed with minor alterations. Speed should be lowered to 400 or 450 fpm and the relief angle should be increased to 7 degrees.

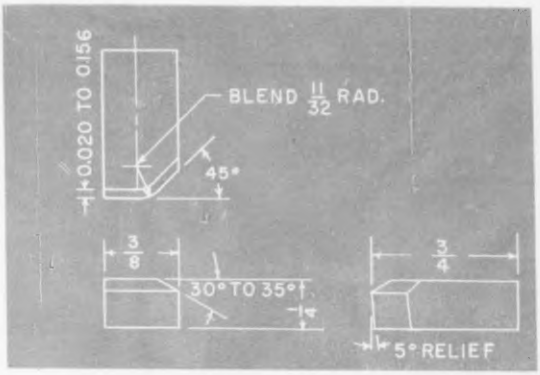


Fig. 2. Rectangular cemented-oxide insert used in first series of turning tests. When held in a special neutral-rake holder, long and consistent tool life resulted.

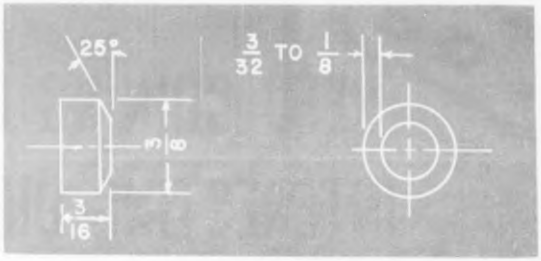


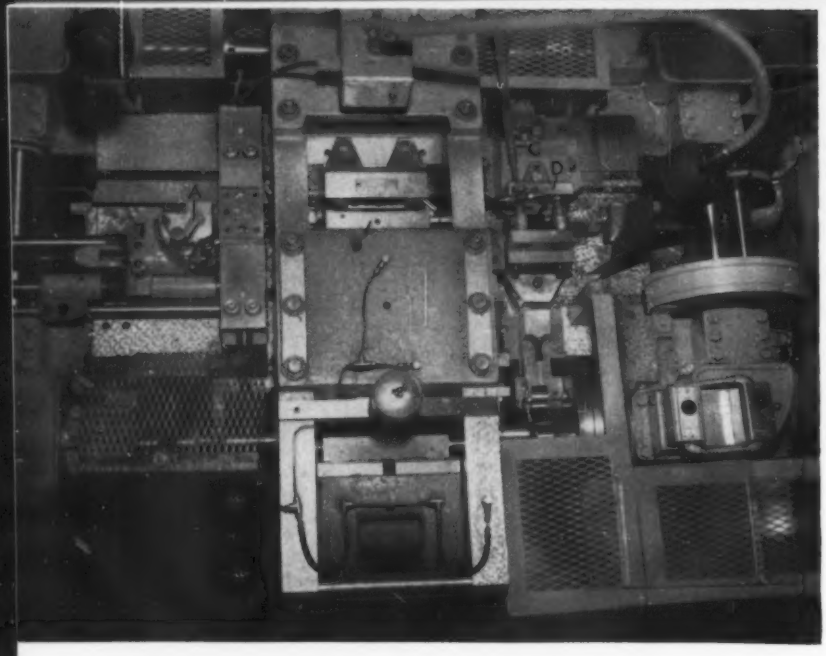
Fig. 3. This disposable 3/8-inch diameter cemented-oxide insert performed satisfactorily during turning tests and gave excellent results during boring tests.

During this operation it is critical that the cutting edge be maintained 1/32 to 1/16 inch below the center line of the work. This will yield a finish ranging from 30 to 80 micro-inches A.A.

It is essential that the negative lands be ground uniformly to produce a dead-sharp edge and that the inserts be placed on a flat carbide seat in the holder. Also, it is necessary that the clamping pressure be distributed evenly across the top of the insert.

Honing of the cutting edge after grinding is not recommended. A sharp edge develops less tool pressure, gives a freer cutting action, and develops less frictional heat.

A comparison can be made between the time necessary to grind the periphery of the bearing race and the time necessary to turn it with the tools described. When grinding, a total of 2.81 minutes was required: when turning at a speed of 700 fpm, the outside diameter was brought to size in 2.13 minutes. An even greater time difference was noted on larger bearing races; for example, a race having an outside diameter of 36.200 inches. Here, grinding required 132.9 minutes, as compared to turning at 600 fpm, which required only 41.9 minutes.



Top view of the Multi-Slide. Wire enters feeding mechanism (A), is flattened by tooling in toggle unit (B). Aligned in fixture (C), the strip is cut off by the punch and die (D).

REED COINING GOES THROUGH INTERESTING DIE DEVELOPMENT

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THE PROBLEMS ENCOUNTERED in compressing a round wire into reeds having flat, parallel sections for a switch required a considerable amount of study before they were solved. One of the switches is shown in Fig. 1. It is composed of a glass envelope containing two identical reeds, or contacts (Fig. 2).

The compressing (coining) of the reed ends must leave them flat and without twist, so that while they are being held by Section A and sealed in the glass, the contact areas at Section B will be in the same plane. The reeds are made of an alloy of 50 to 51 per cent nickel, about 47.9 per cent iron, and small amounts of manganese, silicon,

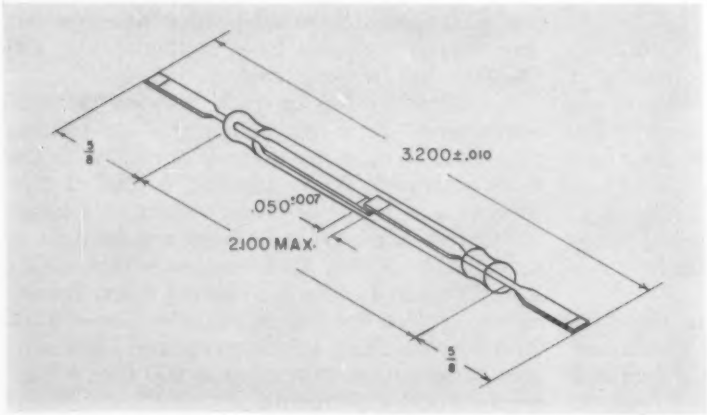


Fig. 1. The switch consists of two iron-nickel reeds extending from opposite ends of a sealed glass envelope.

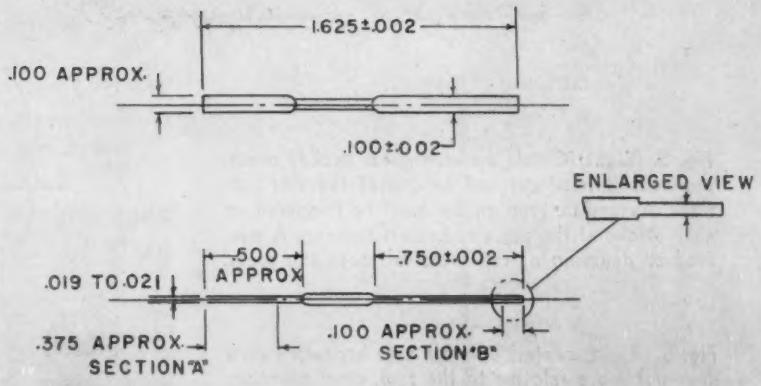


Fig. 2. (Right) The two sections of the reed must be flat and in the same plane after the coining.

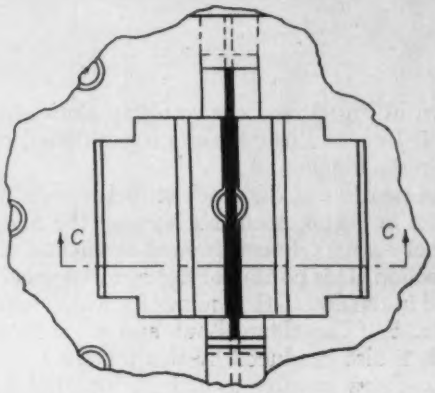
Fig. 3. (Center) Original tooling was modified so that both flat sections of the same reed were coined simultaneously.

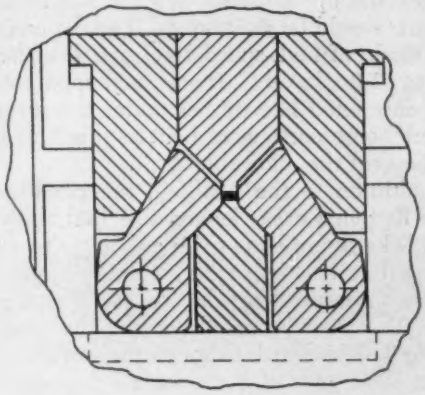
and cobalt. They are produced at the rate of seven million per year on U. S. Multi-Slide machines equipped with 100-ton lever presses, or toggle units. A view over the bed of one of the machines appears in the heading illustration.

As a preparatory step, the wire is heat-treated to de-gas it so that the glass can be bonded to it without forming bubbles in the seal. As a result of this heat-treatment and previous annealing by the supplier, the material has a tensile strength of 87,000 psi and is dead soft. Since it also is badly bent and kinked, the roller straightener normally used on Multi-Slides had to be replaced by a rotary straightener.

Initially, the tooling was designed to form a single flat section which was then cut off to yield the 1/2-inch-long flat on one reed and the 3/4-inch-long flat on another. But because the rotary straightener through which the wire passed before being fed to the toggle unit introduced a prohibitive twist in the material, the two flat sections in each reed were skewed.

This condition was corrected when the tools were changed to flatten both ends of the same reed simultaneously. The modified design is





SECTION C-C

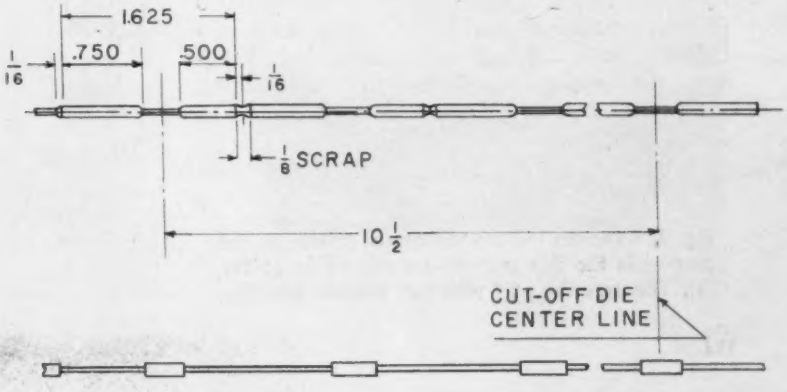


Fig. 4. The stock strip as it looks after leaving the toggle unit. In the cutoff, necked areas in the strip will be eliminated.

Fig. 5. (Right) Cutoff die eliminates necked areas, produces thinned-out end on one of the flat sections. Automatic stop on die must be triggered on each stroke of the press to keep it running. A misfeed or doubling of the material stops the press.

Fig. 6. (Right, center) Because wire beneath punch does not move relative to the tool, steel members wore out, producing curvature in wire cross-section.

shown in Fig. 3, and the resulting stock strip in Fig. 4. In actual use, the die is positioned on its side in the toggle unit.

The necking of the stock strip between parts, as seen in Fig. 4, occurred because the material was not completely constrained at the end of the die section. This portion of the material was eliminated in the cutoff, the tooling for which appears in Fig. 5. (The thinned-out end of Section B, Fig. 2, is also produced by this tooling.)

It was now possible to make substantial quantities of reeds, learn how well the coining dies would stand up, and how well the parallelism of the parts would be maintained. The die members were made of high-speed steel and heat-treated to 61 to 63 Rockwell C. It was soon apparent that these dies acted like rubber under the pressures exerted. Some parts were bent as much as 0.010 inch beyond the allowable limit.

In addition to the bending, the cross-section of the flattened areas looked like that shown in Fig. 6. The figure shows the condition to an exaggerated extent, of course, but the amount of curvature produced by the tool wear was intolerable. The wear occurred because the wire was made to flow outward, although the surface of the wire at the center of the punches did not move relative to the tool.

The compressive strength of the steel members as heat-treated was 120,000 psi. A heavy-impact carbide having a compressive strength of 360,000 psi was next substituted for the steel. Solid carbide was used, rather than brazed-on inserts, because the brazing material and the steel backing

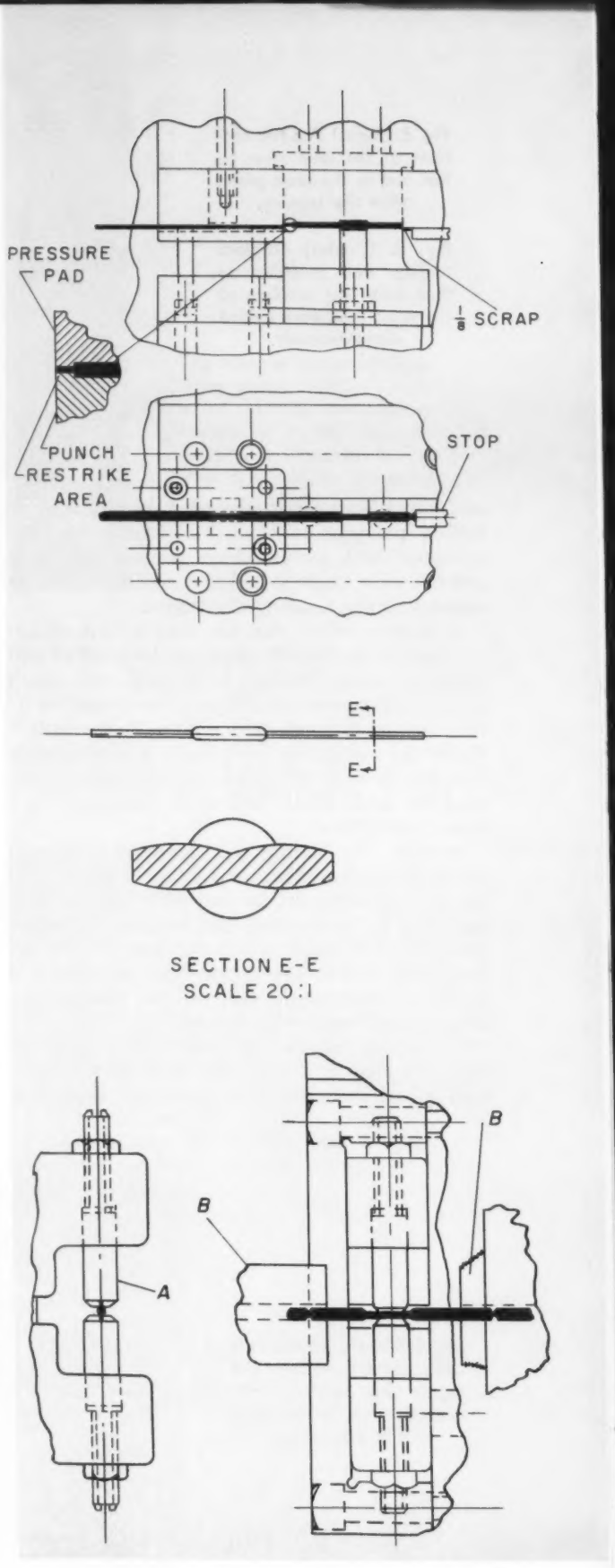
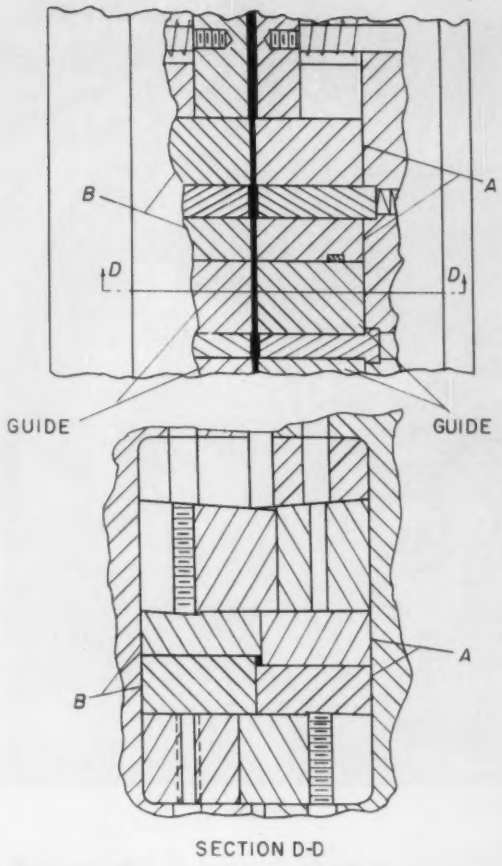


Fig. 7. Hammers (A) tap the center section of the part while the flat sections are aligned by guides (B). This sets the part with flat sections parallel.

Fig. 8. In the closed position of the die, the flat sections are developed when the wire is constrained by the carbide blocks (A) and (B).

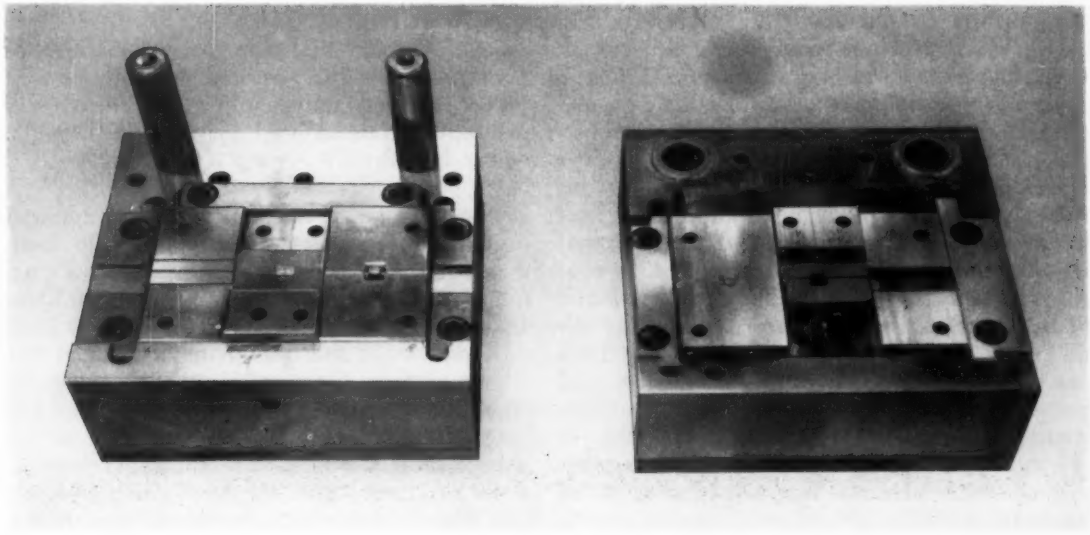


would deflect too much. With the carbide, reed production was raised to 400,000 parts and more per grinding.

The use of carbide solved the flatness problem, but did not improve the parallelism between the two sections of the reed. This problem arose because the material flows axially under the dies as well as outward. The material flowing toward the center produces a slight S bend in it which straightens partially when the part is released. To overcome this bowed condition, a straightening die, Fig. 7, was added.

Finally, the tool was redesigned to be made of simple, solid carbide blocks held in a yoke, as shown in Figs. 8 and 9. Fig. 8 shows the tool on its side, as it is positioned in the machine. Reeds produced with this tool are within the requirements specified in Fig. 2. Parallelism of the flattened sections is held within a total of 0.004 inch, and thickness, within 0.0002 inch. At the same time, production was increased from 3600 to 6600 reeds per hour, and the number of parts per grinding, from 250,000 to 1,500,000.

Fig. 9. In its final state of development the tooling consisted of an arrangement of solid carbide blocks.



A digest of a timely paper presented at the William Park Woodside Panel Conference of the National Metals Congress of the American Society for Metals

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CUTTING-TOOL MATERIALS— TODAY AND TOMORROW

IN REVIEWING past and present progress, it seems likely that the next five years will bring tremendous developments in cutting-tool materials for higher machining speeds, better resistance to wear, and greater consistency in their performance.

The demand for reduced manufacturing costs has never been greater, particularly now that industry seemingly is faced with a 3 to 4 per cent wage boost each year. Expenditures for research in metallurgy and cutting materials are at an all-time high. When it is realized that 15,000,000 tons of chips are produced annually, at a total cost of some $10,000,000,000, a small across-the-board saving can mean a great deal.

Recently, a representative of a tool company told me that its objective ten years from now is to cut metal at 8000 sfm (surface feet per minute). I have no doubt that that goal will be reached, perhaps even earlier, by that company or some other. Most certainly, our present need for increased production to keep pace with higher wages has already been set for many years to come.

We are all interested in new tool materials primarily because of their potential in faster metal removal. Sometimes, however, we jump from what we have to what appears to be better and often forget or ignore the work that is being done on the old and tried materials. I know that I, for one, have been guilty of the thinking that high-speed steels were rapidly being replaced by tungsten carbides. True as that may be in one respect, it is also true that much development work has been done on the high-speed steels which has made them tremendously important to

the metal-cutting industry. Many of us, I believe, have overlooked this fact.

With all this talk about the amount of material turned into chips each year, the cost involved, and the demand for reducing costs, a recent survey disclosed that carbides were being employed only on about one machine in three. Even more surprising, almost half of the machines used by industry today are of such a vintage as *not* to be suitable for carbide tooling!

High-Speed Steels

Those now using the ordinary high-speed steels —either the tungsten-base or the molybdenum-base type—would do well to consider the "super" high-speed steels. The latter, containing from 3 to 5 per cent cobalt and 5 per cent vanadium, are hard, tough, and wear-resistant, and are quite effective in machining alloy steel. Their chief advantage is an increase in useful life (amount of work done per tool grind) of two to six times, rather than an ability to remove metal faster, although surface feet per minute can be increased on many applications.

Tungsten Carbide

Steel-cutting grades of tungsten carbide were introduced in the early 1930's. During World War II, their use became widespread. Between 1946 and 1950, tungsten carbide made by vacuum sintering gained wide acceptance. This process, with alloy additions, has improved both the cutting speed and the toughness of the tool by 25 to 50 per cent.

Our own experience demonstrated that for material having a Brinell hardness of 163 to 223, cutting speed could be raised 40 per cent; with hardness from 223 to 321, 25 per cent; and with hardness from 321 to 363, 20 per cent. Also, on cast iron, a general increase of 50 per cent in cutting speed was possible. Table 1 shows how vacuum sintering of one grade of tungsten carbide has made possible increases in speeds in turning various types of steel.

Titanium Carbides

Around 1952, there appeared a new tool material, often referred to as a cermet, having titanium carbide as its principal ingredient. The compound contains 64 per cent titanium carbide, 34 per cent molybdenum carbide, and a balance of iron and/or nickel—all of which are in good supply and non-strategic. While the material lacks the toughness of current steel-cutting tungsten carbides, its rate of metal removal is two and one-half to three times as great. Compared with the hardest grades of tungsten carbide now in existence, the titanium-carbide material is reported to show only one-half the wear at the same speed, feed, and depth of cut.

There are, however, several drawbacks to the use of titanium carbide at the present time that must be recognized. First, from a quality-control standpoint in manufacturing, it is difficult to produce a consistent product. Secondly, at higher cutting speeds, there is a greater tendency for chipping because of the extreme hardness of the material. Finally, titanium carbide can be brazed only with some degree of difficulty.

We are using titanium carbide in our own shop in studying surface-finish improvement, since it is a fact that the more rapidly metal is cut, the better the finish, feed for feed. At the moment, the material exhibits better impact strength than do ceramic tools.

Another cermet, one about which I am not at liberty to disclose too many details, is being tested by a large firm, with extremely good results. The product includes both nickel and molybdenum, and its titanium carbide content is higher than 64 per cent. On experimental production runs at 1100 sfm, it surpasses the ceramics in useful life by approximately 50 per cent.

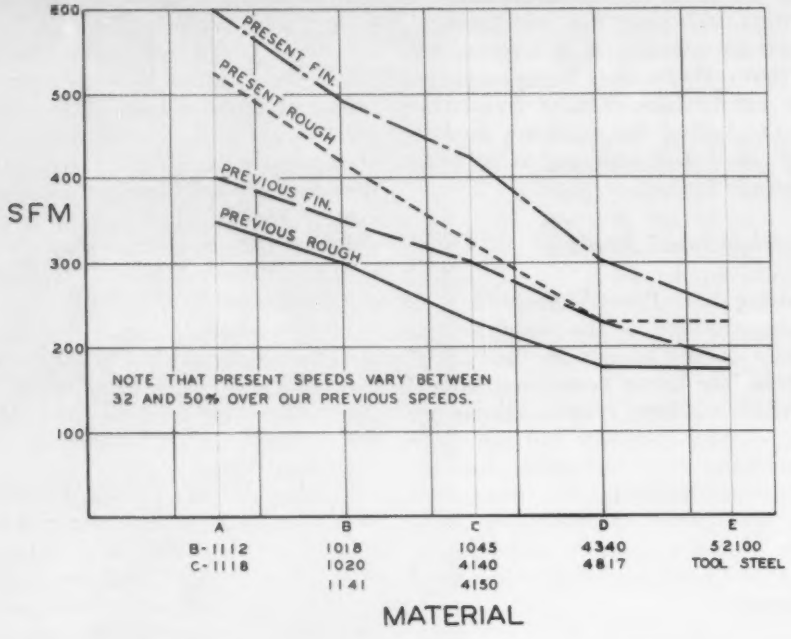
Ceramics

In February, 1955, the Watertown Arsenal announced it had developed an aluminum-oxide ceramic material that would cut steel as easily as paring an apple. Though preliminary and premature, the announcement had an electrifying effect. The government's interest in developing this material was to obtain a non-strategic replacement for tungsten carbide, should the supply of tungsten be cut off. Garbled reports showed that Russia was conserving its supply of tungsten for other tool steels by successfully substituting ceramic cutting materials.

While the advent of aluminum-oxide ceramics as a cutting-tool material is quite recent, investigations of its use go back as far as 1905 to the work of a Dr. Buchner in Germany. Results of later research showed up in the form of British patents in 1906 and 1912, and a German patent in 1913. Other studies on the refinement of aluminum oxide, by a Dr. Reskoyvecsh, appeared in 1924 and 1934. The original work on the British ceramic, Sintox, began in 1935. In Russia, from all available evidence, active development started around 1948.

In our own country, many tool companies initiated their own work on ceramics soon after the Watertown announcement. Gradually, manu-

Table 1. How Vacuum Sintering Increases Turning Speeds with Carbides



facturing costs were cut and quality was improved. In the past year, an attempt has been made by alloying and other methods to produce a consistent product of the highest density by the cheapest method—cold-pressing. Today's ceramic tools are three to five times tougher than the 1955 originals.

Ceramics have a definite place as finish-turning tools for uninterrupted cuts. Because of their high welding-on temperature, ceramic tools work well on hard materials that resist cutting by other tools. They readily cut abrasive material such as cast iron, with relatively greater resistance to wear.

There is considerable advantage in using ceramics to cut metal in the upper hardness range (Rockwell C 40 and above), and as a replacement for some grinding operations. Because of the better finishes obtained and higher speeds possible with ceramics, harder material is being machined with greater ease. The possibility of replacing grinding operations offers a tremendous incentive to its use.

Two Russian ceramics—Thermocorundum and Microlite—have been reported taking finishing cuts at 10,000 to 12,000 sfm. Interrupted cuts, at lower speeds, produced no tool breakage. It has been nearly impossible to obtain Russian ceramics in this country, although some sources have them and have tested them, with disappointing results.

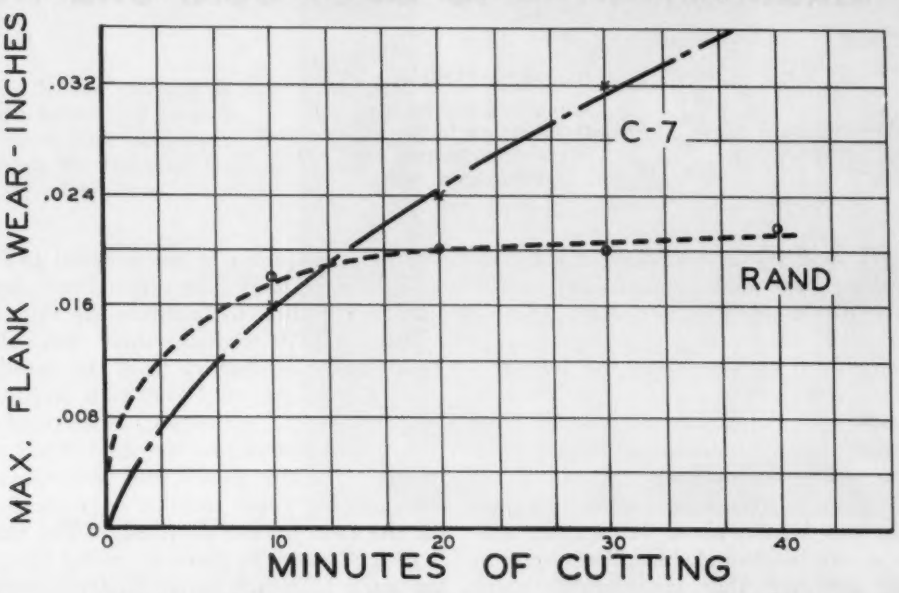
There is a great deal of speculation about the type of tool geometry the Russians are using. This might in itself have some bearing on their success. Indications are that they use positive rake, not negative rake as we do. Also, their side cutting-edge angle is greater—20 to 60 degrees—whereas ours is from zero to 15 degrees, with 25 degrees as an extreme.

Apparently, however, there is more than the matter of tool geometry behind Russian achievement. We built two cutters according to their geometry, only to find that the tools could remove but one-twelfth the material the American type could. Even when operated at the Russian speed recommendations, they performed only 25 per cent as well as our own tools did.

Titanium Boride

Tools of titanium boride have been tried by the Rand Laboratories. They have also been the subject of work sponsored by the American Society of Tool Engineers at the Armour Research Foundation. In Table 2 is shown the tool wear of the material developed by the Rand Laboratories compared to that of Grade C7 tungsten carbide. It can be seen that the titanium boride wears

Table 2. Tool Wear of Titanium Boride Compared to Grade C7 Tungsten Carbide



rapidly at first, then tapers off to a point where it wears less than tungsten carbide.

Rand was attempting to develop a new jet-engine bucket blade when it came across titanium boride. When used as a tool, the material was able to machine a high-speed steel milling cutter having a hardness of Rockwell C 62 at 100 sfm.

The work at Armour has been with nickel-titanium diboride and the iron-aluminum dodecaboride systems. Tests on the nickel-titanium diborides disclose many of the desirable properties of the cemented carbides. A hardness value of Rockwell A 89 to 91 was obtained in an alloy containing 20 per cent nickel and 80 per cent titanium diboride. One of the problems here is that the bond has a low melting phase which may give some trouble.

The iron-aluminum dodecaboride was difficult to alloy by cold compaction and sintering. Hot pressing and sintering or arc melting were attempted, to produce an equilibrium in the alloy. The resultant matrix was still too brittle.

Cemented Diamonds

There are other cutting-tool materials which, in hardness alone, show great possibilities. One of them consists of cemented diamonds. Since the fine crystals of the diamonds are weak, their application as a tool material will very likely be in combination with larger crystals, probably with random orientation for greater strength.

The stumbling block at the moment is that there is no known binder that will work, since the diamond is a metastable form of carbon which at ordinary pressures slowly inverts to graphite at 1650 degrees F. Another problem has to do with tool wear, because it is never known just when natural diamond crystals will fail. Besides, will failure be due to a fracture of the diamond or to wear of the binder?

Speculating further, it appears that cemented diamond tools will be assigned to light finishing cuts. Such cuts might require revolving the tool instead of the work. It is conjectural whether this type of metal removal will be considered turning or grinding, or "turning-grinding."

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Foamed Metal Sandwiches

Foamed metal for sandwich-construction cores is being made by melting a base alloy of 95 per cent aluminum and 5 per cent magnesium; adding a foaming agent; releasing the hydrogen from this agent; and solidifying the foamed metal.

Titanium Drawing is Both Cold and Hot

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IN INVESTIGATING the best design for a high-strength casing for a small General Electric turbine, it seemed desirable to replace the aluminum casting ordinarily used with a two-piece shell of formed and welded titanium sheet metal. Besides the favorable heat resistance and strength of titanium, a casing made of this material would have less mass than one of aluminum and thus be even lighter. The new design is shown in Fig 1.

At GE's Aircraft Accessory Turbine Department, little was known about fabricating titanium. The severe bends and difficult contours in the casing indicated that considerable work would be required to properly evaluate the use of this metal for the part. Also, the developmental nature of the work precluded costly tooling during the preliminary stages.

In line with some previous experience in forming titanium, it was decided to use available press equipment with conventional tooling of gray cast-iron. Because it was realized that heat would be required, a die material like Kirksite could not be used. The original cast design was modified slightly to facilitate the forming.

Type RC 70 titanium sheet was selected as being most satisfactory from the standpoint of weight, strength, and corrosion resistance. Because of weight limitations, a thickness of 0.032 inch was the maximum specified. Tools consisted of a blank-holder, punch, and two separate lower die sections. These sections were similar except for the radii on the draw edge. The first had a 3/16-inch radius to allow for metal flow, and the second, a 1/16-inch radius for the proper setting of a flange on the casing.

The setup was made in the 187-ton Bliss double-action press seen in Fig. 2. Blanks from the titanium sheet were obtained by shearing. An extra 1/2 inch of material was left around the periphery for gripping by the blank-holder. Both sides of the blanks were coated with a drawing lubricant. During the die tryout, stainless steel was temporarily substituted for the titanium because of the high cost of the latter.

In the first attempt at forming, the blanks were drawn cold to a depth of 3/4 inch. Then the parts were heated to 400 degrees F. and the die to 300 degrees F. and drawn deeper. However, this low heat proved insufficient to complete the draw to the full depth (1 1/2 inches). Successive trials with increased temperature indicated the parts had to be heated to 950 to 1000 degrees F., and the dies, 800 to 900 degrees F.

It was found upon inspection that several parts had developed deep cracks. Metallographic examinations revealed that these cracks were caused by the repeated heating during the testing, which produced an oxide scale and in turn caused stresses to be set up in the areas of severe deformation. As a result, the heating of the work and the dies was restricted to the final draw.

For one-half of the casing, the schedule consisted of drawing the work cold in three progressive steps to a depth of 1 3/16 inches. An

Fig. 1. Two formed and welded halves of titanium sheet make up this turbine casing.

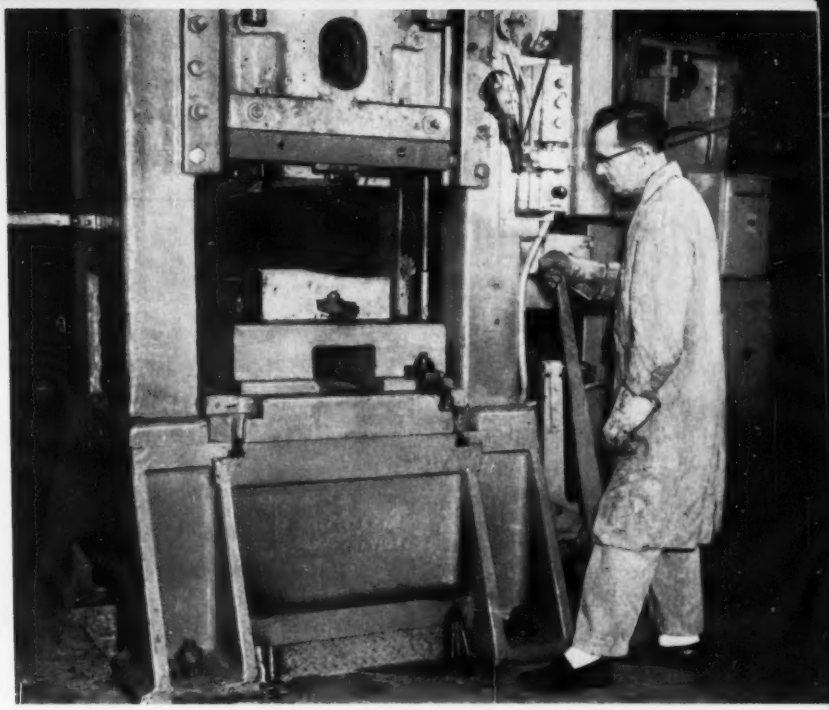


Fig. 2. The titanium is first drawn cold in progressive steps, then heated (as are the dies) for final draw.

insert was then added to permit material to be gathered for the final set. The work next was heated to 950 degrees F. and the dies, to 800 to 900 degrees F. for the final draw to a depth of 1 1/2 inches. The radius was then set on the flange to eliminate spring-back.

A similar schedule was followed for the other half of the casing, with the addition of an annealing operation between the second and third cold draws, to eliminate any possible stresses. The work was heated to 1000 degrees F. for five minutes, then cooled in air.

The appearance and condition of both halves were satisfactory, and subsequent metallurgical tests indicated no stress-cracking or defects. These conclusions were reached:

1. Titanium sheet of 0.032 inch thickness and greater can be drawn cold to a considerable depth. In this instance, 80 per cent of the full depth was drawn cold.
2. Where sharp corners or radii exist, the work and dies require heat to set them.
3. Titanium can be readily formed with conventional tooling.
4. To conserve the titanium, stainless steel can be used for the die tryout. (The number of draws required for the titanium will be about three times as many as for the stainless steel.)

Cornell Engineers Sweep Welded Design Contest

Five engineering undergraduates at Cornell University received all of the top awards in 1958 in the annual mechanical and structural welded design competition sponsored by The James F. Lincoln Arc Welding Foundation of Cleveland, Ohio. This is the first time in the eleven-year history of the competition that students in one school have taken the three top awards.

The Lincoln Foundation makes forty-six awards each year recognizing the engineering ability of college undergraduates in the field of welded design. Awards are made for both mechanical and structural designs which involve a significant use of arc welding. The Foundation also awards scholarship funds to the colleges of the recipients of the three top awards.

The First Award of $1250 went to Richard Jarvis of Baltimore, Md., for his design of a triangular-shaped footbridge. John Jenner and E. R. McLean of LeRoy, N. Y., and Philadelphia, Pa., respectively, shared the $1000 Second Award for the mechanical design of an automatic welding machine. Gordon Kraus and Robert Spicher designed a display arboretum which received the $500 Third Award. Cornell in turn received $1750 in scholarship funds, to be administered by its mechanical and civil engineering colleges.

The 1958-59 rules booklet for the current competition is now available from The James F. Lincoln Arc Welding Foundation, Cleveland 17, Ohio. Undergraduates in all branches of engineering are eligible to participate.

Plasma Arc Torch Applies "Unworkable" Materials

PRODUCTION USES of the plasma arc torch for fabricating parts and applying coatings that will withstand temperatures above 5000 degrees F. have been announced by the Linde Co., Division of Union Carbide Corporation, New York, N. Y. The Linde-patented torch, seen in the heading illustration, can melt the toughest materials known without itself being consumed by the intense heat generated—up to 30,000 degrees F. Accurate parts can be rapidly produced from ultra-hard materials.

The plasma state occurs when gas is heated to such a high temperature that it is at least partially ionized. In the plasma arc torch, the arc is struck over a short distance between a tungsten cathode and, usually, a water-cooled copper anode. A layer of cool, non-ionized gas insulates the arc column, preventing it from touching the wall of the nozzle. The metal or substance to be worked is prepared in either wire or powder form, and is then passed through the intense arc struck inside the torch.

Because of the enormously high heat of the arc, the material passing through it is converted into a fluid or plastic state. It is then carried out of the torch by inert gases flowing at high velocity—up to 10,000 mph—and is finally deposited on the part with such force that a firm bond results.

Pure tungsten, molybdenum, zirconium, and tantalum, as well as hard carbide materials and even precious metals, have all been used successfully. In fact, most inorganic materials that melt without decomposing can be employed. In addition to experimental rocket and missile parts of pure tungsten or tungsten-coated graphite, the torch has already been used to produce high-density tungsten crucibles for metallurgical purposes, special parts for nuclear work, sensitive electrical contacts, and electronic components and X-ray targets of superior density. A variety of parts produced in this way is shown in Fig. 1.

There are no known limitations on size or complexity of shapes. Accuracies on the order of plus or minus 0.002 inch can be maintained. In producing parts over a mandrel, the latter can subsequently be removed by leaching with nitric acid, caustic, or other materials.

Where formed parts are not required, the torch can be used to coat virtually any material, including reinforced plastic, with a wide variety of metallic or refractory platings. Many multiple-layer coatings are also possible. Linde does not plan to market any equipment at this time, but the company is prepared to accept orders for parts-coating or fabrication, either in production or in experimental quantities.

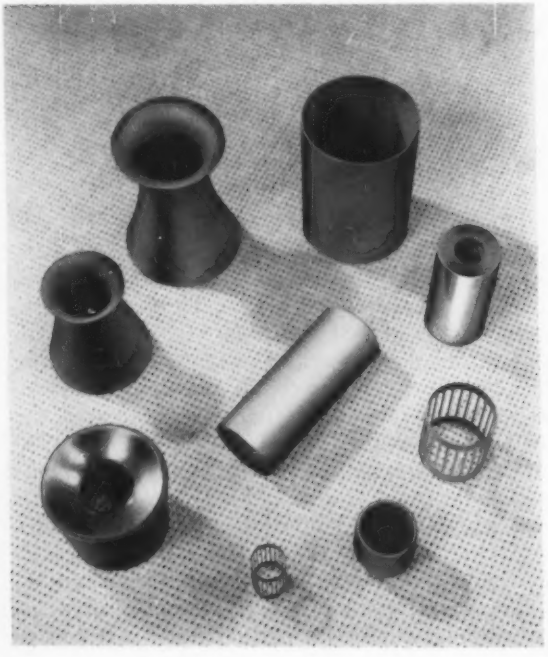
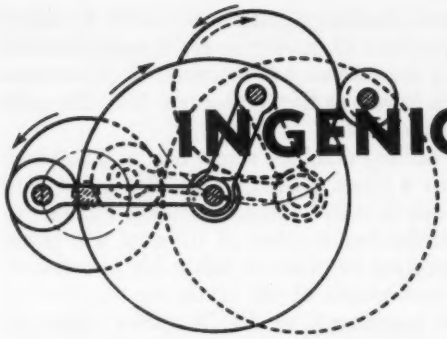


Fig. 1. Rocket nozzle made of graphite and coated with pure tungsten is seen at bottom left. Above left are two rocket-nozzle liners made of tungsten. Tungsten and tungsten-coated tubes are shown at center and top right. At the bottom right is a crucible of pure tungsten, and the openwork parts are grid cages of high-density tungsten for electronic tubes.



INGENIOUS MECHANISMS

Mechanisms selected by experienced machine designers as typical examples applicable in the construction of automatic machines and other devices

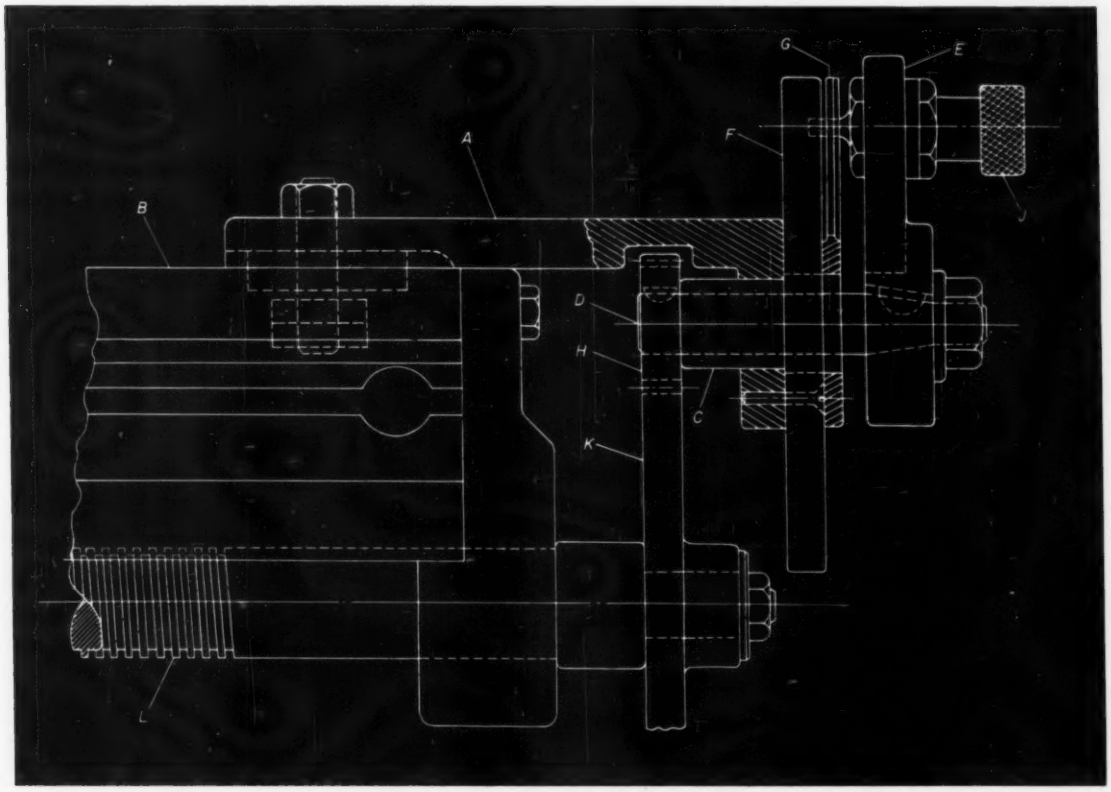
Pi-Ratio Universal Rack-Indexing Attachment

ALFRED K. THORNTON, Yonkers, N. Y., and

JAMES R. HANSEN, Bellevue, Wash.

Racks of different pitch can be cut on a milling machine equipped with the indexing attachment here illustrated, without any change of gears being required. One particular two-gear combination and one or more commercially available index-plates can be used to accurately index a milling machine table for cutting racks in all the commonly employed diametral pitches. Although this gear set is for use on machine tables having a feed-screw with a 1/4-inch lead, effective gear arrangements may be set up for other leads.

The linear pitch of a rack is equal to π (3.1416



This attachment for the milling machine facilitates rack-cutting. The same gears can be used to produce racks in all commonly used diametral pitches.

inches) divided by the diametral pitch. Consequently, the number of teeth in 3.1416 inches of rack will be equal to its diametral pitch. A gear set chosen for the indexing attachment must be able to move the milling machine table 3.1416 inches with a number of turns of the crank-handle that can be readily subdivided by the diametral pitch. An ideal gear set is one that can be used with a small selection of index-plates to index the table the exact amount for a rack of any standard diametral pitch.

The ideal condition can be obtained on machines having 1/4-inch lead feed-screws with a 71- and 113-tooth gear used in combination. Ideal arrangements or close approximations may be set up for other leads with two- or four-gear combinations.

Construction of the attachment as set up for two-gear operation is illustrated. Bracket *A*, which is keyed and bolted to the machine table *B*, supports bushing *C*, shaft *D*, crank *E*, index-plate *F*, sectors *G*, and gear *H*. A spring-loaded plunger *J* for indexing is mounted on the crank. Gear *K* is keyed to the feed-screw *L* of the milling machine table.

If the milling machine screw has an 0.250-inch lead, then 4 times 3.1416, or 12.5664 turns, will be required to move the table 3.1416 inches. An easily subdivided number of turns of the crank should be used to produce this table movement. Twenty revolutions of the crank are required to move the machine table 3.1416 inches when the 71- and 113-tooth gears are used, and the accompanying table shows how commonly used pitches are indexed. This ideal combination will theoretically move the machine table 3.141593 inches or π inches to six places with 20 turns of the crank, as 20 turns times 71/113 gear ratio times 1/4-inch lead of feed-screw equals 3.141593 inches of table movement. The 71-tooth gear

Index Settings for the Pi-Ratio Universal Rack-Indexing Attachment Based on a Commercially Available Index-Plate

Diametral Pitch	Number of Complete Index Turns	Fraction of Turn to be Indexed	Number of Index Holes in Circle	Number of Index Holes for Setting	Diametral Pitch	Number of Complete Index Turns	Fraction of Turn to be Indexed	Number of Index Holes in Circle	Number of Index Holes for Setting
128	0	5/32	96	15	8 1/2	2	6/17	68	24
120	0	1/6	54	9	8	2	1/2	66	33
96	0	5/24	72	15	7 1/2	2	2/3	54	36
80	0	1/4	72	18	7	2	6/7	84	72
72	0	5/18	54	15	6 1/2	3	1/13	78	6
64	0	5/16	96	30	6	3	1/3	54	18
56	0	5/14	84	30	5 1/2	3	7/11	66	42
48	0	5/12	72	30	5	4	...	any	0
44	0	5/11	66	30	4 1/2	4	4/9	54	36
40	0	1/2	66	33	4	5	...	any	0
36	0	5/9	54	30	3 1/2	5	5/7	84	60
32	0	5/8	72	45	3	6	2/3	54	36
28	0	5/7	84	60	2 3/4	7	3/11	66	18
24	0	5/6	54	45	2 1/2	8	...	any	0
22	0	10/11	66	60	2 1/4	8	8/9	54	48
20	1	...	any	0	2	10	...	any	0
19 1/2	1	1/39	78	2	1 7/8	10	2/3	54	36
19	1	1/19	76	4	1 3/4	11	3/7	84	36
18	1	1/9	54	6	1 5/8	12	4/13	78	24
17 1/2	1	1/7	84	12	1 1/2	13	1/3	54	18
17	1	3/17	68	12	1 7/16	13	21/23	92	84
16 1/2	1	7/33	66	14	1 3/8	14	6/11	66	36
16	1	1/4	72	18	1 5/16	15	5/21	84	20
15	1	1/3	54	18	1 1/4	16	...	any	0
14 1/2	1	11/29	58	22	1 3/16	16	16/19	76	64
14	1	3/7	84	36	1 1/8	17	7/9	54	42
13 1/2	1	13/27	54	26	1 1/16	18	14/17	68	56
13	1	7/13	78	42	1	20	...	any	0
12 1/2	1	3/5	60	36	15/16	21	1/3	54	18
12	1	2/3	54	36	7/8	22	6/7	84	72
11 1/2	1	17/23	92	68	13/16	24	8/13	78	48
11	1	9/11	66	54	3/4	26	2/3	54	36
10 1/2	1	19/21	84	76	11/16	29	1/11	66	6
10	2	...	any	0	5/8	32	...	any	0
9 1/2	2	2/19	76	8	1/2	40	...	any	0
9	2	2/9	54	12					

should be mounted on the crankshaft *D* and the 113-tooth gear on the feed-screw *L*. It should be emphasized that with this arrangement these gears will not have to be changed to produce racks in any of the commonly used diametral pitches. Furthermore, racks based in design on the metric module system may be indexed using only a 127-hole circle.

Linkage for Combined or Independent Lineal Travel

WILLIAM N. DE TURK, Hatfield, Pa.

A critical element and an auxiliary element of a mechanical system can be linked to a common actuator in such a way that either the two operate together, or the critical element operates alone, if the auxiliary element is jammed.

Heart of the linkage device is cylinder *A*, held in a fixed position in bracket *B*. Within the cylinder are two tubular slides—inner slide *C* and outer slide *D*. Cable *E*, entering the cylinder from the left, is joined to plunger *F*. Around the plunger is coil spring *G*. The other end of this cable is connected to the critical element (not shown) through clevis *H*.

Another cable *J*, entering the cylinder from the right, is joined directly to slide *D*. The other end of this cable is connected to the auxiliary element (not shown) through clevis *K*.

The device functions as follows: When the critical element is operated, it pulls the plunger to the left. The spring, being heavy, resists compression under normal load, and restricted by end plate *L*, causes the inner slide to move as a unit with the plunger for 1/4 inch of free travel. At this point, the end plate contacts the bottom of the outer slide.

Then, for a second 1/4 inch of travel, the plunger, inner slide, and outer slide move as a unit. Since cable *J* is joined to the outer slide, the auxiliary element operates with the critical element during the second 1/4 inch of travel. This is the desired movement.

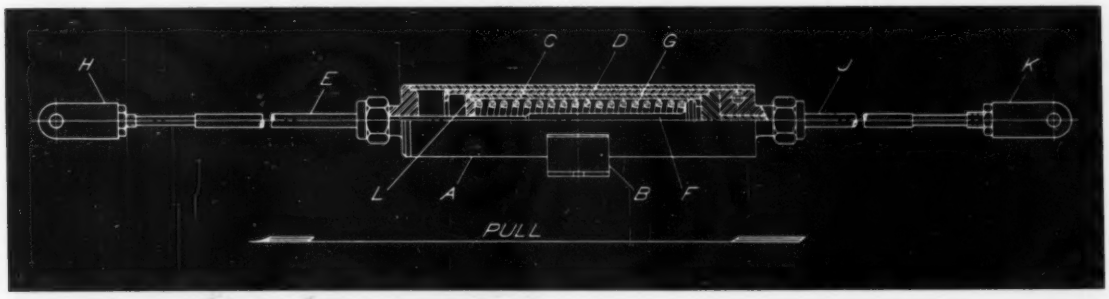
On the other hand, assume that the auxiliary element is jammed. Then, in the second 1/4 inch of travel, the plunger will travel independently of the inner slide, which has now been immobilized by the stalled outer slide. During this movement, the spring is compressed by the pull on the plunger through the operation of the critical element.

A practical application of this device is found in fighter aircraft. The critical element of the system is a seat ejector, and the auxiliary element, a headrest latch release. In this instance, the spring around the plunger has a 100-pound preload. Spring rate is 100 pounds per inch. The additional 25-pound load, when created by the freezing or jamming of the headrest latch release, is reduced to about 1.4 pounds at the input because of a 1 to 18 ratio of the pulling force.

* * *

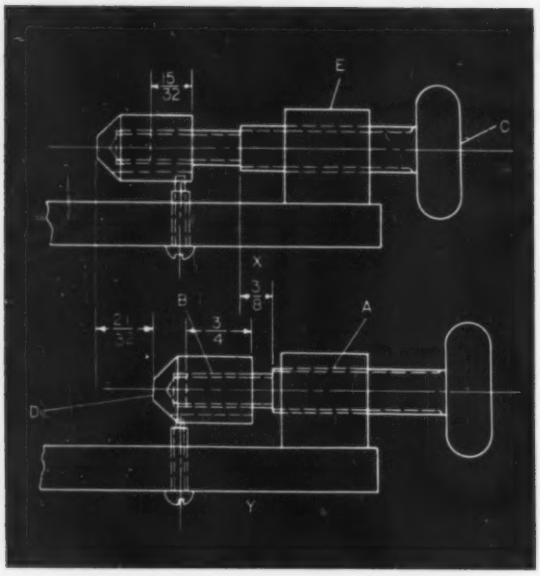
Carbide Tools Reduce Burnishing Costs

Carbide burnishing tools have been adopted by Ward Fasteners Inc., Atlanta, Ga., to remove burrs on aluminum or brass slide-fastener parts after their assembly in cotton tape. The operation consists of pulling the assembled tape over and under two rotating burnishing tools. Each tool is made from a piece of Grade K6 Kennametal, 1/4 inch in diameter and 2 9/16 inches long. On one end a section 1 5/8 inches long is ground to an octagonal shape, the distance across the flats being 0.2 inch. After one hundred sixty hours of operation — eight times the life of the tools formerly used — there was no apparent sign of wear.



During the second 1/4 inch of travel, slide (D) normally moves with slide (C). If the auxiliary element is jammed, neither slide moves, and spring (G) is compressed.

SHOP KINKS



Screw clamp with two threads that insure fast and dependable action.

Screw Clamp with Double Feed

C. ANDREWS, Dayton, Ohio

Hand-operated clamps on jigs and fixtures have the disadvantage of sometimes loosening due to vibration during a machining operation. This is especially true when successive workpieces vary in width or length.

The illustration shows a clamp designed in such a way as to be unaffected by vibration. It consists essentially of a screw having a 1/2-inch diameter, right-hand thread at *A* of 12 threads per inch and a 3/8-inch diameter, left-hand thread at *B* of 16 threads per inch.

When handle *C* is turned to tighten button *D* against the work, the button is moved by the action of threads *A* and *B* as they engage, respectively, the tapped holes in bracket *E* and in the button. The double action is obtained because button *D* is prevented from turning so that it must move forward. Turning of the button is prevented by a screw end in a slot that extends lengthwise along the bottom of the button.

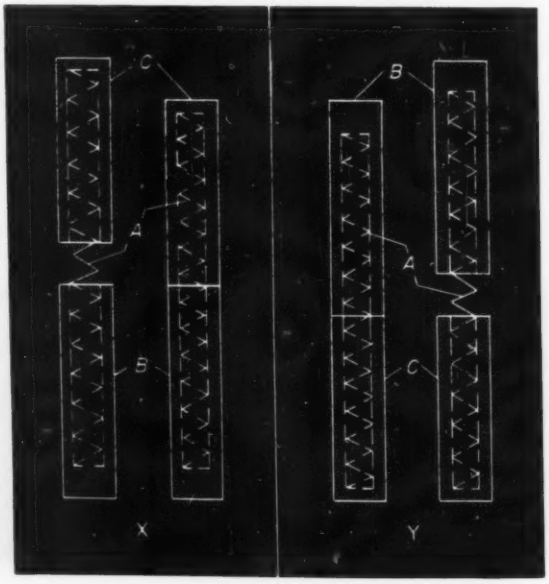
Four and one-half turns of handle *C* will move the clamping button a distance of 21/32 inch as indicated by the two positions seen in views *X* and *Y*. A one-half turn of the handle moves the button 0.073 inch.

Convenient Spring-Testing Device

ERNEST JONES, New York City

A simple yet unique arrangement for testing small-production lots of light compression springs can be easily produced from two pieces of bar stock. As seen in the illustration, a hole, a little larger in diameter than the springs *A*, is drilled in one end of each piece. The combined length of the two holes is made equal to the length to which the springs are to be compressed for testing. In addition, the undrilled ends of the two bars are cut off at lengths having, respectively, the maximum (cup *B*) and minimum (cup *C*) weights to be supported by the spring at the testing length.

To use this device, a spring is first dropped into cup *B*, and cup *C* is placed over it. If the spring is too soft, cup *C* will compress the spring and rest in contact with the lower cup *B*, as shown at the right in view *X*. All springs which raise cup *C* above cup *B* are not too soft but may be too stiff. To complete the test, the arrangement is inverted, leaving the spring inside the cups. In this position, the cups will not be separated by an acceptable spring. A spring that raises cup *B* above cup *C*, as seen at the right in view *Y*, is too stiff.



A simple arrangement used for testing springs.

TOOL ENGINEERING *Ideas*

Tools and fixtures of unusual design and time- and labor-saving methods that have been found useful by men engaged in tool design and shop work

High-Speed Attachment for Large Drilling Machines

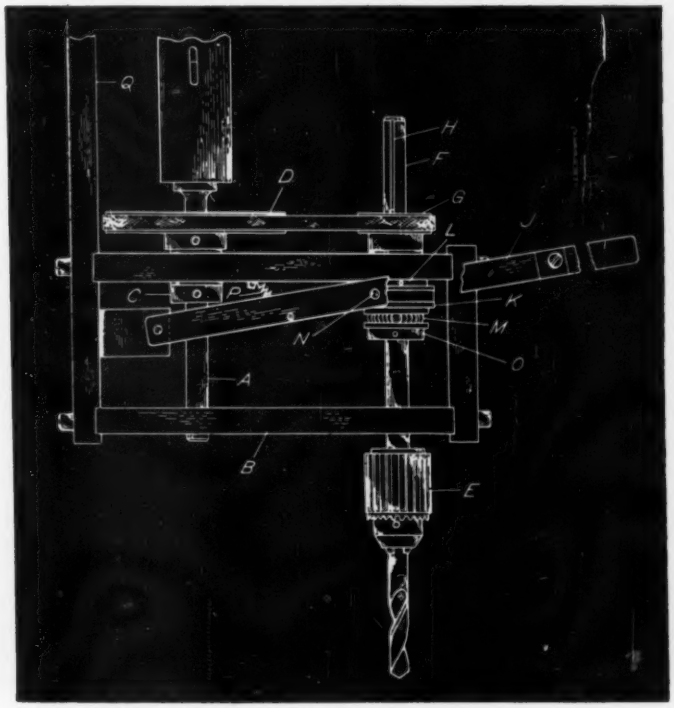
CLINT MCLAUGHLIN, Rockaway, N. Y.

An attachment providing high speeds and a sensitive hand feed for large drilling machines not originally equipped with these features is here illustrated. By this device, heavy and unwieldy work-pieces that require holes of both large and small diameter can be drilled on a machine of this type, and thereby eliminate the necessity of setting up the part twice.

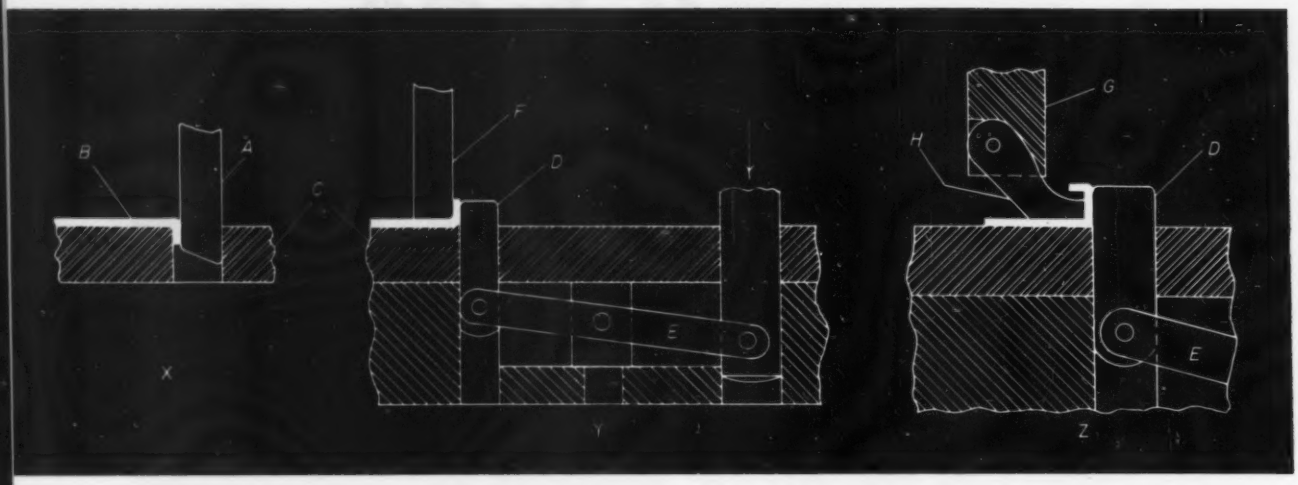
The spindle of the drilling machine drives the mechanism by means of the tapered shank of shaft *A*. This shaft also supports frame *B* as collar *C* and pulley *D* are both secured in place. Drill chuck *E* is mounted on the lower end of auxiliary spindle *F*. Pulley *G* is keyed to drive this auxiliary spindle but is free to slide along the keyway *H*. The two pulleys have a 3 to 1 diameter ratio. A sufficient range of speeds is obtained by varying the main spindle speed.

Forked lever *J* for the sensitive hand feed pivots on the frame at one end and straddles the rectangular collar *K*. Mounted between collar *L* and ball thrust bearing *M*, this rectangular collar is a free fit on the auxiliary spindle and is grooved on two sides to receive the pins *N*. Since collar *L* and collar *O* are both affixed to the auxiliary spindle, any movement of lever *J* is transmitted through pins *N* to collar *K* and the spindle *F*. A spring *P* holds the lever in the raised position.

The frame of the attachment is kept from revolving by the back plate *Q* which extends upward to rest against the arm of the machine. A guard can be added for the pulleys and belt.



This attachment permits the drilling of small-diameter holes located in work usually handled on a large, slow-speed drilling machine.



Automatic feeding of strip stock in progressive dies can be facilitated by forming bends upward.

Inverted Punches for Progressive Bending Dies

FEDERICO STRASSER, Santiago, Chile

Progressive dies are often designed to incorporate one or more stations for forming or bending. These operations are commonly performed by an upper punch *A*, which bends a portion of the work-piece *B* downward into a recess in a stationary die-plate *C*, as seen at X in the illustration. If bending is accomplished in this manner, automatic feeding is sometimes made difficult or impossible because of the height to which the strip must be raised for each advance.

This problem can be eliminated by arranging the die to bend the work upward as shown in view Y. A lower punch *D*, located in the die-holder, is actuated through a lever *E* by a member attached to the ram of the press. Lever *E* simply converts the downward movement of the ram to an upward movement of the punch. The bending is done against a punch *F* attached to the upper part of the die. A suitable compression spring (not shown) effects the return of the lower punch.

The same setup may be used to form a U-bend after a simple right-angle bend has been made, at a previous station. However, a somewhat more complicated upper punch *G* (view Z) must be employed. This punch has an additional pivoting member *H* which ordinarily hangs in a vertical position. When the press ram descends, this member is rotated to a position against the work-piece, thus supporting it during the bending operation.

Tooling for Precise Shaving of Stampings

RICHARD MINSER, Cleveland, Ohio

Air-operated equipment that accurately shaves the edge of a stamping along a circular arc is here illustrated. The operation is performed by rotating the work-piece on a horizontal turntable past a series of fixed cutters. Although designed for a particular part, this arrangement may be adapted for similar applications.

Built into the top of a cast-iron table, the device consists basically of a faceplate *A* mounted on a spindle *B* that rotates in precision bearings *C*. Under the faceplate and secured to the top of the table is a hardened disc *D*. The disc is in contact with the bottom of the faceplate.

The lower, threaded end of the spindle is keyed to an operating lever *E*. Retained by a nut and washer, this arm is rotated through an arc of about 130 degrees by means of an air-operated cylinder *F* which is clevis-mounted to the bottom of the table. The faceplate *A*, spindle *B*, and disc *D* are all precision ground from hardened tool steel. Suitable provision is made for lubrication between the contacting surfaces of members *A* and *D*. The bearings are mounted in a housing *G* which extends below the table top.

Tool-holder *J* carries three carbide-tipped tool bits. These tools have 3/8-inch-square shanks and

are clamped in square-to-round adapter sleeves brazed into holes drilled in the tool-holder. Two set-screws locate and secure each of the tools. The bits are square-ended but have a top relief with the high side to the right.

Each tool cuts with a shearing action—the side thrust forcing the work against the faceplate rather than lifting it. The first tool is set to take a heavy roughing cut. The other two remove about 0.002 inch each to obtain a fine finish. An 0.010-inch stock allowance should be provided for trimming.

A spring-mounted pad *K*, machined in the form of a circular segment, wipes against the part to hold it in place during the cutting stroke. The pad is made of a hard copper-bronze for wear resistance and is beveled at the approach end. The thrust from the die springs *L* is taken by a bar *M*. This bar is bent into a U-shape, and mounted on two blocks *N*. Stripper bolts retain the pad.

Air ejection of the stamping at the end of the work stroke is accomplished by having two holes in the faceplate line up with an air passage in disc *D*. As the air cylinder piston pauses before snapping back to the load position, the work-piece is blown clear of the faceplate. A few simple sheet-metal guides direct the trimmed parts into tote pans.

In loading the device, the work-piece is positioned by a pin *O* in the center of the faceplate. A block *P* is also secured to the faceplate to serve as a drive for the part. The hold-down pad forces the stamping against the plate before it makes contact with the cutting tools.

With the part in place, the operating cycle is started by depressing a key to open the air valve. The air enters the cylinder and forces the piston-rod out to turn the faceplate in a counterclockwise direction. As the part rotates it slips under the beveled edge of the hold-down pad *K* and is trimmed by the three cutting tools. At the unload station the part is automatically ejected by air supplied to passage *R* through a hose connected by means of fitting *S*. The air cylinder then resets the device for the next stroke.

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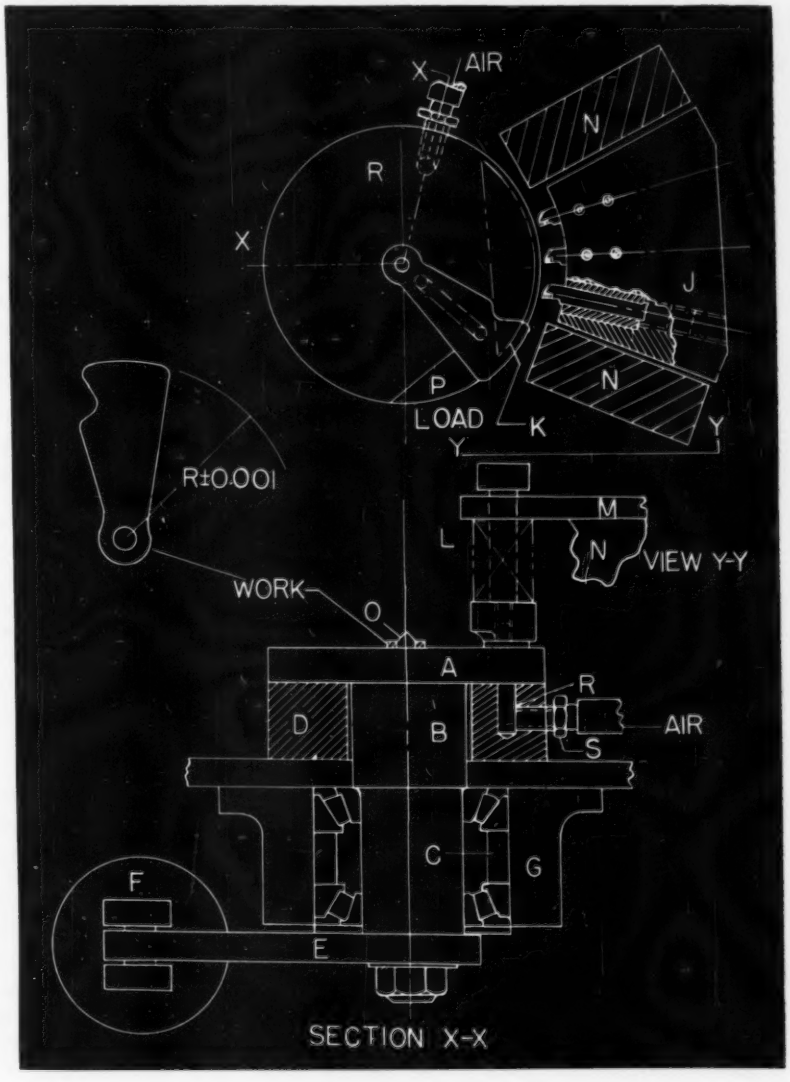
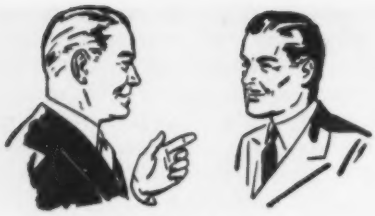
A total of 166,000,000 passenger cars, motor trucks, and buses have been produced in the various automotive plants in the United States during the past fifty-eight years.



Device with an air-operated turntable for shaving the edges of stampings to obtain an accurate radius.



Talking With Sales Managers

BERNARD LESTER
Management Consulting Engineer

Make Your Own "Boomlet" This Year

A MAJOR DIP in general business gives a shock to every member of an industry group. The more you shake a barrel of nuts or bolts for instance, the more their positions change. It is this way with builders of tools and allied equipment, for the way one company reacts to a business famine differs greatly from another. That is why, in a period such as we have been going through, small companies will start to rise and climb to the top. This year will see a further reshuffle in the position of companies, and the position of each will depend on how well it seizes opportunity on the spur of necessity.

An examination of the plans of several sales managers who have taken an offensive position shows some interesting angles of attack. As might be expected, it reveals a universal concentration on common phases of marketing such as new and improved products; organization and territory rearrangement; added sales promotion; sales training; the reduction of friction and waste; and the stepping up of sales effort. But some ideas outside the familiar category deserve notice. Since they may be ideas you have overlooked, we are going to repeat what certain sales managers have said.

"In our chase to develop new machines and better design features—and we have several in process—we overlooked the importance of finding new users for those items of equipment we now sell. We have been surprised recently to discover potential customers in areas our salesmen were visiting. During the present year these will add to our sales volume at very little added selling cost."

"During the last year we have come to realize the terrific cost and also the risk of tearing an account away from an alert and well-heeled competitor. Prospects of this sort we now select very carefully, and only for an all-out attack. What we concentrate on is to find smaller prospects and then intensify our struggle to develop them into large customers."

"When it comes to developing a sales organization, we have done a lot of work in training men. It has helped, but our men are not nearly as resourceful as they should be. Part of this has been our fault because I think we tried to mold men too much to a pattern. Now we are making a much closer study of each man with the idea of putting the right one in the right place and then piling on the responsibility."

"Over the last few years we have softened too much. We didn't step right up, study the situation, make a prompt decision and take risks as we should have done. We are all happiest when we meet a challenge, and prouder of the company when it avoids 'feather bedding.' Guess industrial relations in the past have gone too much to our heads instead of our hearts."

"We have a lot of facts and know-how in our group. We have been great gatherers of information! But a man amounts to nothing unless he puts to use what he knows. This idea is one we will stress this coming year."

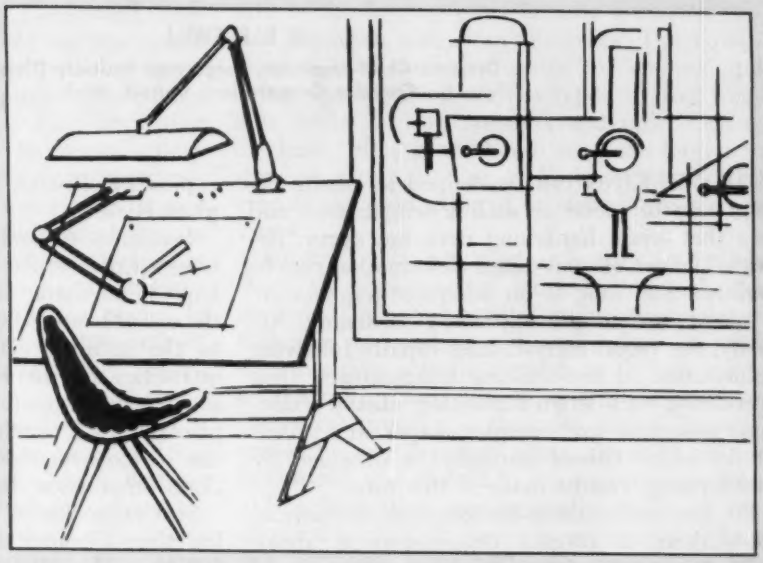
"In spite of an accelerated program of promotion, we have now come to realize that we are not selling the improved quality that our factory has been working into our machines during the last year or so."

"We are getting scared over the increasing proportion of our sales that goes directly to meet military demands. We plan to reduce risk by changing this ratio."

"We are more and more convinced that what helps to get the buyer's favorable decision is showing him that we know about new production methods that apply to what he builds. For this reason we are fixing a lot of our effort on getting our sales engineers up to date on the very latest equipment, materials, facilities, and processes. For instance, we found our men poorly informed on new means for automatic inspection, something which is complex, yet most important to us in making sales. Informing prospects meshes right in with persuasion."

Technological changes mark this year as one of great potential for the equipment builder. The company that rises to the top in 1959 will be the one with a courageous sales group that invents new ways to make its own "boomlet."

MACHINERY'S *Reference Section*



WHAT THE DESIGNER SHOULD KNOW ABOUT PRODUCTION

HOT-FORGING—Part 4

January 1959

What the designer should know about production — Part 4

HOT-FORGING

R. B. BOSWELL
Division Chief Engineer, Forge and Foundry Division
Chrysler Corporation, Detroit, Mich.

HOT-WORKING can be defined as plastic deformation of metal at such a temperature and rate that strain hardening does not occur. Repeated blows or continuous deformation can be performed as long as an adequate temperature is maintained to prevent strain hardening. Actually, the metal recrystallizes rapidly following deformation at hot-working temperatures, thus preventing such strain hardening. Heavy reductions in section size, complex shapes, and severe bends, which cannot normally be obtained by cold-forming, can be made in this way.

For low- and medium-carbon steels, the normal hot-working or forging temperature is above 1800 degrees F., extending to a maximum of about 2350 degrees F. In contrast, aluminum and aluminum alloys are normally forged in the range of 700 to 900 degrees F.

Hot-working is also employed for other reasons besides its ability to provide heavy deformation of metals. For example, hot-working improves the mechanical properties of metal in definite directions, and imparts beneficial grain-flow characteristics.

The quality of forgings is determined to a great degree by the quality of the basic steel from which the forgings are made. Particular attention must be paid to the cleanliness of the steel poured into ingots, the cropping of unsound metal from the ingots, the temperature of rolling, the amount of scarfing after rolling, and other steel-mill practices.

Starting with hot-rolled bar stock or billets, the principal hot-working methods used in the forging industry are as follows: hammer- or smith-forging, drop-forging, machine- or upset-forging, press-forging, roll-forging, and extrusion. Each of these methods has definite applications based on both the design and volume of parts to be produced. Choice of a particular method is usually determined by economic consideration of these factors, together with others such as capital investment, labor cost, depreciation, and plant layout.

Hammer- or smith-forgings are formed between a pair of flat or open-face dies, with perhaps some shape being given to the piece by the use of hand tooling. This method is employed to the greatest extent where relatively small quantities are involved and where the finished shape can be readily completed by additional machine work, or where the work is of too large a size or too irregular a shape to be contained in closed-impression dies.

Size range varies from very small forgings of less than a pound to large parts weighing over 200 tons. The general range of smith-forgings is handled on steam hammers of the open-frame type, while the very large parts are made on large hydraulic forging presses.

Drop-forgings are produced by compacting and shaping the hot, plastic metal with closed-impression dies. Intermittent impact pressure of the hammer blows refines the grain of the steel billet or bar through successive stages, and improves the physical properties of the steel. This method is employed in producing forgings ranging in size from less than an ounce up to several hundred pounds. Quantities vary from a few to millions of duplicate pieces. In general, drop-forge hammers used in commercial practice are of either the gravity or steam type. Steps in the drop-forging of connecting-rods are illustrated in Fig. 1.

Trimming presses are required to remove the flash around the edge of a drop-forging. This thin metal flash, squeezed out by the impact pressure when the hot metal fills the die cavity, is subsequently sheared off in a set of trimmer dies. The trimming press is usually located near the hammers to permit hot-trimming of the parts as soon as they are forged. However, cold-trimming is often used, particularly on parts forged two or more at a time from a single piece

of stock. Punching or coining operations also may be included with the trimming.

Machine- or upset-forgings are produced by the squeeze-pressure method, instead of by impact force, as in the drop-hammer. The closed-impression dies of the forging machine serve a double purpose, being designed to grip the stock in a horizontal position as well as to carry impressions into which the hot metal is pushed by a punch on the header ram. The heated stock is inserted between the movable and stationary halves of the dies against a gage, which permits a suitable amount of metal to project beyond the gripping portion of the dies. This projecting metal is then struck by the impression-cavity die set in the header ram, resulting in upsetting. As in drop-forging, machine-forging may require several steps to develop the finished shape. As many as six steps are sometimes incorporated in the dies, and may include bending and trimming. Forgings weighing from less than a pound to about 500 pounds are produced by this method. Successive forms produced in upsetting pinion-gear blanks are seen in Fig. 2.

The forging press is employed to produce a large variety of impression-die forgings, and has come into greater use in recent years. Best results are obtained on parts which are reasonably symmetrical in shape and on which only one or two preparatory steps are required. It is often advantageous with press-forging to produce small, irregularly shaped parts in pairs. In this process, the squeeze-pressure method is employed, as in the forging machine, but the press operates vertically instead of on a horizontal plane. Gripper dies to hold the stock are not normally utilized, and the hot blank is merely set in place in the lower die impression.

Impression-die forging presses are normally of the mechanical type. Mechanical presses capable of operating at a high forging speed are used to make steel and alloy forgings up to about 100 pounds in weight. The heavy, squeeze pressure of the forging press imparts a smooth surface condition with close tolerances. This equipment is also used frequently for coining and sizing operations on various types of steel forgings made in drop-hammers and upset-forging machines. Ring-gear blanks are press-forged in steps as shown in Fig. 3. Press-forging is also used in the production of crankshafts, as seen in Fig. 4.

Forging rolls are used primarily to reduce short, thick sections of stock to long, slender sections. The action and technique are similar to that of a steel rolling mill except that the stock does not pass entirely through to the other side of the rolls. The operator inserts the stock in successive grooves in the rolls, called "passes," where the bar is picked up by the rolls, shaped to contour, and ejected in the opposite direction.

Hot extrusions are generally made in mechanical presses of the type used for press-forging, although large hydraulic presses are also being used for this purpose. This process differs from press-forming primarily in that the metal blank is forced to flow continuously, usually in a vertical direction, by pressure exerted through

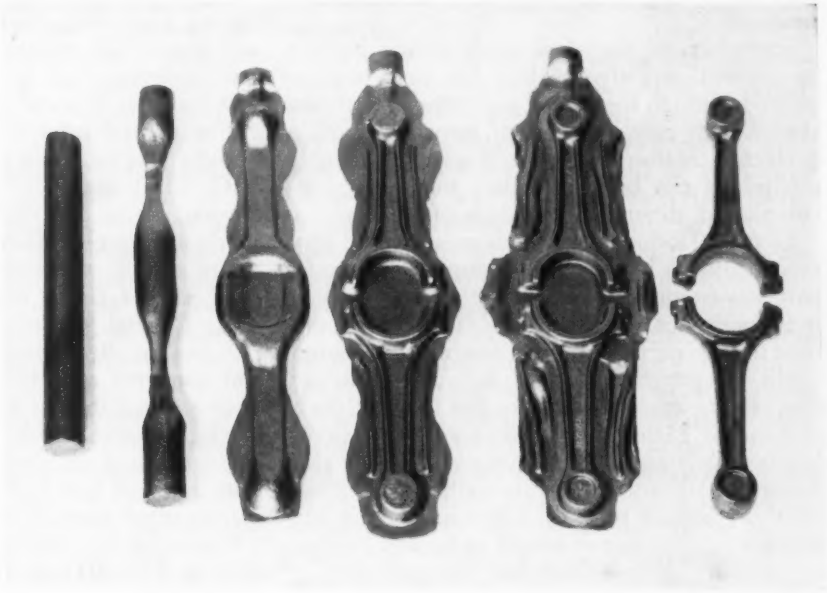


Fig. 1. Automotive engine connecting-rods (seen at right) are drop-forged two at a time from round bar stock (shown at left).

Fig. 2. Successive shapes produced in forging blanks for differential pinion gears with closed-impression dies on an upset-forging machine.

movement of the upper die. Both open and closed dies are used, depending on the shape of the part desired.

The most common type of forge furnace in commercial use today is the slot type, which can be either gas- or oil-fired. An efficient furnace of this type will normally heat between 50 to 100 pounds of steel per hour, per square foot of hearth area. Continuous, pusher, and rotary type furnaces are also finding increasing use as the forging industry becomes more mechanized. The choice between pusher or rotary type heating furnaces is often dictated by available floor space and plant layout. The use of the continuous type has definite advantages in that the stock is heated at a constant rate for a definite length of time, resulting in economies in heating and practically eliminating the possibilities of over- or underheating.

Protection of the steel stock during heating to prevent excessive scaling has been accomplished through the use of protective gas atmospheres. However, the cost of providing such a protective atmosphere with presently available equipment can be higher than the savings accomplished through elimination of scaling.

Electrical induction methods are also used very successfully in heating for forging. For the most part, low-frequency motor-generator sets varying in frequency between 1000 and 10,000 cycles are used for this purpose in order to obtain maximum depth of penetration with minimum heating time. However, for stock sizes less than 1/2 inch in diameter, higher frequencies are needed. Combination low- and high-frequency units are also available. Advantages of this method of heating are short heating times (a 2.0-inch diameter bar requires as little as one minute to heat to forging temperature, using 3000 cycles), less scale formation, and longer die life. Nevertheless, these savings are usually offset by the higher cost of electrical energy in many areas, and the high, initial capital expenditure required for equipment. Electrical, resistance type heating and high-temperature salt baths are also used for selectively heating parts for forging in specialized applications. Such localized-heating methods are used for the manufacture of valves, military projectile bodies, and automotive torsion bars.

Forging Dies and Tools

Selection of the proper die steel for a given application depends primarily on the following considerations:

1. Amount of production required.
2. Cost of the die steel.
3. Whether the die impressions are machined before or after hardening.
4. Die operating temperatures.
5. Degree of shock (determined by whether the dies are used in a hammer, press, or upsetting machine).

Of these factors, temperature can be a major cause of early die wear, and must be given utmost consideration.

For low-production operations, relatively inexpensive water-hardening tool steels such as SAE W2, W3, and W4 are used. Although the resistance of these steels to abrasion at high temperatures is quite low, and they tend to distort during hardening, they are readily machinable and attain high surface hardness. They are shallaw-hardening, and as a result, will not develop full hardness internally in heavier die sections.

For normal production operations, more expensive oil-hardening tool steels (such as ASM VIG, VIF2, and VIF3) are used. These steels harden deeper and distort less than the water-hardening steels. When hardened through the entire section of the die-block, they can be resunk several times without further heat-treatment. General-purpose die-blocks of these materials are supplied commercially in the quenched and tempered conditions, at hardnesses ranging from about 270 to as high as 420 Brinell. These blocks are machinable, and require no further heat-treatment after sinking of the impression. They have all but replaced annealed blocks requiring subsequent hardening and tempering.

Chromium type oil- or air-hardening die steels such as SAE H11 or H12 are used where ex-

Fig. 3. Round-cornered, square-shaped billets, made from hot-rolled steel billet stock, are used in forging ring-gear blanks.

tended die life or improved abrasion resistance is required. These steels require heat-treatment after die-sinking but are designed to produce minimum distortion and size change on hardening. Tungsten type oil- or air-hardening die steels such as SAE H20 are used where extreme abrasion and wear resistance are required. They are less shock-resistant than the lower alloy varieties and extreme care must be used to insure good die alignment. These steels are generally used as hot-die inserts in presses, and are installed in holders of lower alloy material having good toughness and shock resistance.

For gripper and header dies where temperatures do not exceed 800 degrees F., medium-alloy, oil- or air-hardening die steels such as SAE H12 or A2 are generally used. For higher temperature service up to 1100 degrees F., the tungsten type oil- or air-hardening die steels such as SAE H20 or H21 may need to be used. The hardness of gripper, heading, or upsetting dies should be in the range of 45 to 50 Rockwell C.

Application and Design of Forged Parts

Some of the advantages which can be obtained through the proper application of forgings are as follows:

1. They can be made from a wide range of materials such as plain carbon steel, alloy steels, aluminum alloys, brass and bronze, nickel alloys, magnesium alloys, stainless steels, and cobalt- and nickel-base high-temperature alloys. Materials that are difficult to machine, such as high-manganese steel, and metals that are difficult to cast, such as titanium, can be readily forged to desired shape.

2. Excellent reproducibility of mechanical properties: The structural uniformity of forgings, their inherent soundness, and their freedom from concealed defects permit a reliable prediction of actual service performance based on calculated stresses. An ample reserve strength and toughness for unpredicted high loads provide more than the usual factor of safety found with other forming methods.

3. Greater opportunity to reduce dead weight and space requirements: Because of the consistency of mechanical properties obtained, plus the controlled directioning of flow lines in the metal structure produced by forging, the design engineer can use a lighter sectional thickness for a given application and still maintain an adequate safety factor. Also, because of the relatively high strength-to-weight ratio attainable with forgings, the over-all size of the part and weight of metal can be kept to an absolute minimum.

4. Welding can be utilized for fabrication of complex parts and structures: Even complex parts which may be impractical or impossible to forge as an integral unit need not lose the advantages obtained by forging. Such complex units may be divided into two or more shapes which can be readily forged and then joined by welding.

5. Forgings respond uniformly to heat-treatment: The mechanical properties obtainable through this process can be reliably predicted. This makes heat-treating of forgings a straightforward production process, which insures a high percentage of acceptable parts with practically no rejects.

6. Forgings are usually free of concealed defects: The compacting of the metal in closed-impression dies provides high soundness, free of concealed defects such as gas holes, shrinkage, large metal oxides, etc., often found with other methods of fabrication. The result is a saving through elimination of scrap of partially machined or finished parts as well as the attendant losses in costly machining time and the repair of damage to tools or machines.

7. Forgings can be shaped to provide substantial machine and finishing savings: Considerable reduction in rough-machining time and material can be saved through proper forging design. Often the size variation at certain desired locations can be controlled on forgings to minimize or even eliminate rough-machining operations. Through proper location of the parting line in relation to the fixtures, complicated machine setups can often be eliminated. Further reductions

in machine finishing time can often be effected by cold-coining or sizing operations.

In designing drop-hammer forgings, a single parting plane (where the upper and lower die faces come together) should be used whenever possible for greatest economy. When the plane must be along a contour, stepped or locked dies may be necessary to equalize thrust, but this can increase over-all costs by as much as 20 per cent. Sharp steps or drops in the parting line should be limited to about 15 degrees from the vertical in small parts, and to about 25 degrees on large parts to avoid tearing of the flash during trimming. A definite location of parting line should be specified on the forging drawing, whenever possible, to minimize variation in shape and to prevent possible chucking difficulties during machining.

Draft, which is the angle or taper required on the sides of a forging for releasing from the die, is necessary for long die life and economical production. Draft requirements will vary from 3 to 11 degrees, or more, depending on the size and shape of the forging. In general, the greater the depth of the die impression, the greater the amount of taper required on the forged piece. Draft is also required on inside surfaces where the metal will tighten on the die as it cools, and is made greater than on the outside surfaces where the metal shrinks from the die surfaces.

Through certain die design expedients, draft can often be held to a minimum and in some cases, even eliminated. This is usually accomplished through judicious location of the parting line in conjunction with locked dies, as illustrated in Fig. 5. Simple, cylindrical-shaped parts of small diameter, if forged in the horizontal position, will often provide their own parting. Also, the ends of cylinders may be forged in locked dies at an angle to avoid draft on the end surfaces.

In forging, some radii in the dies will wear and grow larger, whereas others will grow sharper under the combined effects of pressure and abrasion. Radii that are too small resist the flow of the metal. This prevents proper filling of the die and, in extreme cases, may cause cold shuts. Also, wear at such points may reduce the life of the die.

In general, radii should be as large as the design permits, and still not produce excessive machining costs. In small steel forgings, 1/8-inch radii are considered the absolute minimum, and for steel forgings of average size used in the automotive field (3 to 8 pounds), 1/4-inch fillet radii are normal. This minimum will increase in proportion to the weight of the forging. Fillet radii are normally made about twice the size of corner radii.

The maximum height of a rib or boss developed in forging is dependent on the width at the base, the size of the base fillets, and the temperature of forging. In general, the maximum height of such ribs or flanges which can soundly be developed is twice their width at the base. Parts with ribs of this maximum height are usually forged at temperatures higher than normal (2250 to 2300 degrees F.), and should have fillets twice the minimum size normally used. The use of increased draft and a radius at the crest of the rib will also assist in obtaining this height.

Ribs are more readily formed in the upper die where the temperature of the piece is higher. The lower die extracts heat from the forging, which is constantly in contact with it. Ribs formed in the upper die will also tend to have better surface quality because less scale is left here and it is more easily removed.

Forged holes should not be placed at positions which will obstruct the natural flow of metal in the forging operation. If such holes or cavities lie perpendicular to the directional flow of metal, additional breakdown operations may be necessary on the forging billet before it is placed in the dies for finishing. In almost all instances where a hole is to be punched, bosses must be placed around the hole to provide space for dis-

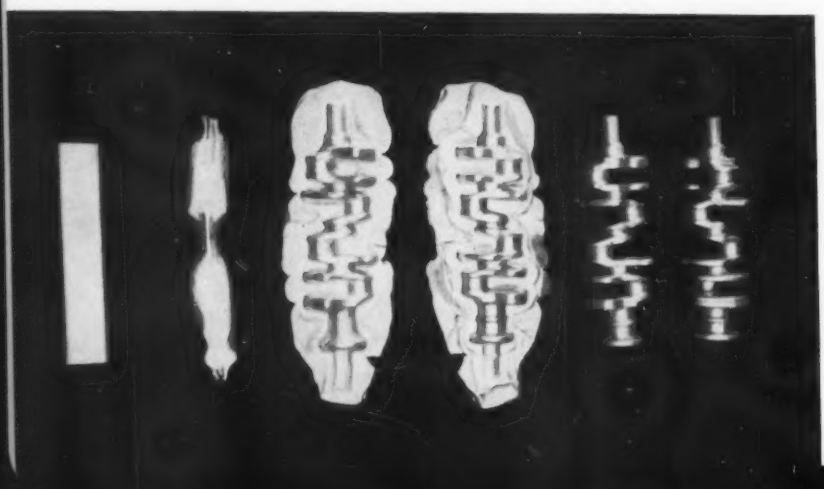


Fig. 4. Automotive engine crankshafts (right) are forged to close tolerances and smooth surface finish on mechanical press.

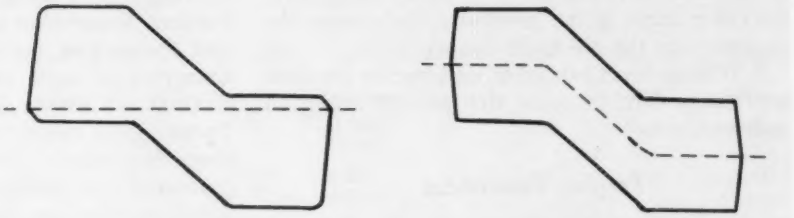


Fig. 5. Draft required with straight die parting, seen at the left, can be reduced by changing parting line and using locked dies (shown at right).

placement of the metal to relieve the work-load on the punch.

In general, holes and cavities should not be deeper than their base diameter when normal fillets are used. However, if a full radius or hemispherical shape is allowed at the bottom of the cavity, the maximum depth may be increased to 1 1/2 times the base diameter. On shallow cavities a draft angle of 7 degrees and normal-size radii can be used. On cavities of maximum depth the draft should be increased to 10 to 12 degrees.

The thickness of the web in forging is limited principally by the temperature to which it cools before forging is completed. In general, for large-volume production, the minimum web thickness attainable is 0.10 inch with shallow depth of indentation, increasing to a maximum of about 0.30 inch with deep indentation above the web. When thinner webs are required, they can sometimes be attained by tapering the web toward the center from 5 to 8 degrees.

There are also certain rules governing hot upset-forging which must be considered in designing parts to be produced by this method:

1. In general, the length of the unsupported stock that can be gathered or upset in one blow without injurious buckling is not more than 3 times the diameter of the bar.

2. If the diameter of the upset is not more than 1 1/2 times the diameter of the bar, lengths of stock in excess of 3 times the diameter can be successfully upset in one blow, providing internal die cavities are used. The application of this rule in conjunction with multiple-pass dies makes it possible to build up metal progressively in steps, where the diameter is increased 50 per cent with each blow. Five or six passes are usually maximum on most commercial forging machines.

To the designer, upset-forgings are of particular advantage where increases in section size are involved. Where several diameters on a common axis are required, this method of forming is particularly adaptable. Deep piercing of a hole on a central axis can be readily accomplished by this method, and small bends are also sometimes made. Trimming can often be accomplished as one step in the die sequence.

Upset-forgings require little if any draft, which saves both material and machining time. Draft angles vary from 1 to 7 degrees, depending on the depth of upset and the design of forging. Corner radii should be as large as design permits, with a minimum of 1/16 inch, except at the outer diameter of the upset face, where little or no radius is required. At the corner where the large upset end joins the original stock, a larger radius is needed. The longer the upset portion, the larger the radius required. As the force applied becomes farther removed, the die cavity at this point becomes more difficult to fill. Under these circumstances, radii as large as 1/4 inch, or a taper, may actually be required. Fillets should conform to the finished contour insofar as possible and should be an absolute minimum of 1/8 inch on simple upsets. Otherwise, design rules and requirements for upset-forgings are much the same as for conventional drop-forgings.

The rules for designing forgings to be made in presses are very similar to those used for upset-forging, except that the pieces must, in general, be of shorter over-all length and of a symmetrical geometry. Because the final die impression is filled in one blow and a knockout mechanism is provided on most forging presses, sticking of the piece in the dies is not a serious problem. Hence, draft angles can be held on the low side (3 degrees or less). Radii can be held to a minimum of 1/16 inch, but 1/8 inch is more often used. Because of the good alignment provided by separate guides between upper and lower dies, little mismatch or variation occurs on the forging at the parting line, thus minimizing machining required at this point.

Although exact rules for hot-extrusion design vary according to the job, the following general observations have been made:

1. In making deep extrusions with an open-bottom die cavity, the smaller the draft angle in the bottom die, the greater the depth to which it will readily fill.

2. In direct extrusion (movement of the metal

in the same direction as the punch), the greater the entry angle in the lower die, the greater the tendency for the die to fill deeper.

3. With indirect extrusion, no taper on the bore is often preferable, since this permits using an undercut punch.

Forging Tolerances

Typical commercial tolerance ranges for various casting processes versus those obtainable by forging are shown in Fig. 6. These tolerances are for general tooling reference only, and are not to be considered applicable to all parts and all conditions. Also, the tolerances given are not across the parting line, and are not applicable to workpieces less than an inch in length. "Close-standard" forgings cost more than "commercial-standard" ones because closer attention to die conditions, heating practice, die setup, and condition and operation of forging equipment must be maintaned. When such close tolerances are desired, the designer should always specify "close standard" on the drawing. The extra cost of the "close-standard" forging tolerances can in some instances be more than justified by savings in subsequent machining, and may result in complete elimination of machining in certain cases.

If more precise tolerances than "close standard" are required, they are classified as "special" tolerances. The designer must specify the actual tolerances required when using "special" tolerances, as well as the dimensions or locations to which they must apply. Tolerances which apply to forgings produced on drop-hammers, forging machines, or forging presses are defined according to weight in a booklet published by the Drop Forging Association entitled "Standard Practices and Tolerances for Impression-Die Forgings." Examples of such tolerances for drop-hammer forgings are shown in the accompanying table. These figures merely serve to illustrate the maximum dimensional variations which may be encountered on commercial-grade forgings. In actual practice, the dimensional variations shown may never be approached, and are greatly influenced by the design of the part and the type of forging equipment on which the parts are made.

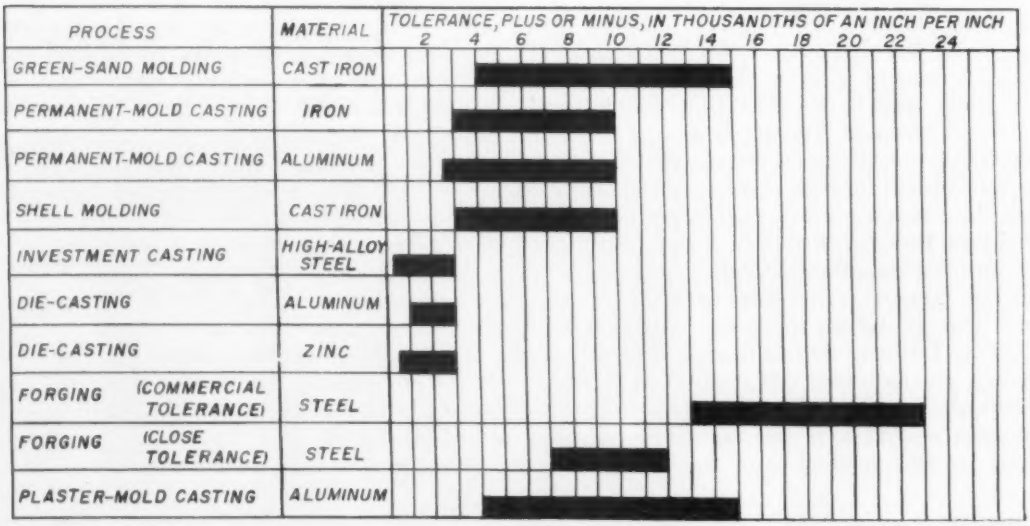
On forged surfaces which are to be machined, additional stock must be added over and above that required by tolerance variations to insure adequate cleanup. This machining allowance will vary from about 0.060 inch minimum for small forgings up to 0.250 inch on large forgings.

Tolerances for hot extrusions are, in general, closer than those made by the drop-hammer, machine, or press methods, except on length, as the end of the die cannot always be closed. This can be attributed to a great extent to the lack of parting-line flash (except at the top) on the body, together with the symmetrical shapes generally associated with hot extrusions. Both outside and inside draft can normally be held to under 3 degrees on indirect extrusions up to 12 pounds, and the extruded end of direct extrusions will have no draft.

Metallurgical Considerations

One of the principal metallurgical characteristics of forged or hot-worked steel is the fiber structure or grain flow induced. During forging,

Fig. 6. Comparison of tolerances obtainable commercially by forging and various casting processes.



Tolerances for Drop-Forgings

Size of Forging		Thickness Tolerance, Inch		Width and Length Tolerance, Inch*		Maximum Outside Draft Angle, Degrees		Maximum Fillet and Corner Radii, Inch	
Weight, Pounds	Dimensions (Length by Width) at Parting Plane, Inches	Commercial	Close	Commercial	Close	Commercial	Close	Commercial	Close
1	2 by 2	−0.012 +0.036	−0.006 +0.018	+0.053 −0.038	+0.029 −0.019	10	8	1/8	1/16
10	6 by 6	−0.022 +0.066	−0.011 +0.033	+0.086 −0.065	+0.047 −0.033	10	8	3/16	3/32

* Composed of sum of shrinkage, die wear, and mismatch. Trimmed size tolerance not included (add approximately 0.035 inch per inch from draft face at trim line).

the coarse metallic grains are broken up, thus producing a finer grain structure. The density of fiber structure is greatest in the outer portion, where the impact pressure is most intense and where the stress in bending or torsion is highest. Tensile tests indicate that the yield strength in the direction of the fiber structure may be increased 2 to 5 per cent over that in the transverse direction. However, this improvement is relatively small compared to improvements found in impact strength, vibrational characteristics, reduction of area, and wear resistance. Impact strengths may be improved by as much as 25 to 30 per cent (based on standard Izod impact tests), and substantial improvements can be obtained in tooth wear over gears made from bars.

Heavy scaling results from excessive temperature or time of heating prior to forging. Such scale can be hammered into the surface of the forging, causing difficulties in machining if not removed by subsequent shot-blasting or cleaning. Also, a pitted surface resulting from scaling on unmachined surfaces, if extreme, may be conducive to early fatigue or impact failure of certain parts. Such scaling results in excessive loss of steel during forging, poor die life, and high furnace maintenance.

All forged parts will show some carbon depletion at the surface as a result of heating unless the lost carbon is restored in subsequent heat-treatment through use of controlled-atmosphere furnace equipment. Also, forging bars and billets, as received from the mill, always have some degree of surface decarburization, even before forging is conducted. The allowable amount of decarburization on hot-rolled steel bar to be used for forging is usually about 0.001 inch per 1/16 inch of bar diameter. An additional 0.005 to 0.015 inch depth of decarburization may be added by heating for forging under normal conditions. If loss of fatigue strength or other mechanical properties from such depths of decarburization are detrimental, it will be necessary for the designer to specify machined surfaces. However, greatly improved fatigue strength can be obtained on as-forged surfaces through shot-peening.

Overheating occurs when the forging stock is heated to such high temperature (above 2350 degrees F.) that the austenite grain size becomes excessively large. This can be so severe that subsequent normalizing, or quenching and tempering, will not completely refine the grain. Such coarse grain results in impaired mechanical properties, and in particular, loss of impact strength.

Laps or folds are surface defects caused by the folding over of hot metal edges, fins, or sharp corners within a forging. No welding of metal occurs within the lap due to pockets of surface oxide or scale. Decarburization is sometimes found adjacent to entrapped scale. Usually such laps or folds are caused by improper die design or excessive mismatch.

Seams are surface defects caused by cracks in the ingot, which are elongated during rolling at the steel mill. Such seams tend to open and cause splitting during forging operations where the metal is expanded and not compacted. Maximum allowable seam depths are normally established by direct negotiation between the mill source and the forging plant.

Piping is a cavity or heavily segregated area formed at the center of the steel ingot during solidification. The piped portion is cropped at the steel mill to prevent its extension during rolling. If cropping is inadequate or improper, piping may appear in finished forgings.

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Metal Quality—published by the Drop Forging Association, 605 Hanna Bldg., Cleveland 15, Ohio.

Forging Handbook—Naujoks and Fabel, published by the American Society for Metals, Cleveland, Ohio.

Metals Handbook, 1948 Edition, and First and Second Supplements—published by the American Society for Metals, Cleveland, Ohio.

Standard Practices and Tolerances for Impression Die Forgings—published by the Drop Forging Association, 605 Hanna Bldg., Cleveland 15, Ohio.

What is a Forging?—published by the Drop Forging Association, 605 Hanna Bldg., Cleveland 15, Ohio.

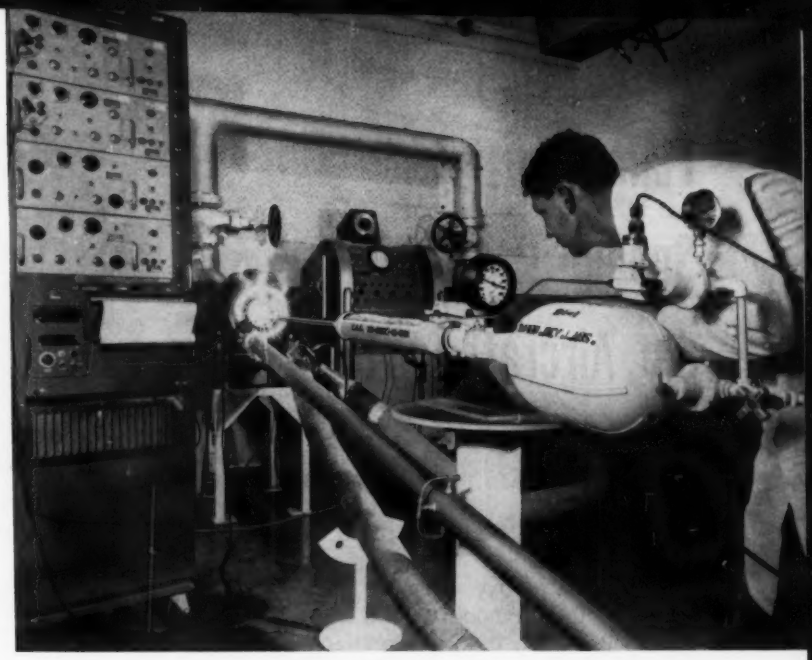
TAPE-CONTROLLED WELDING —Assemblies for Terrier surface-to-air guided missiles are spot-welded four at a time by an inert-gas-shielded tungsten arc, at the Convair (Pomona) Division of General Dynamics Corporation. Heli-arc technique used completes spot welds from one side of work. Data on punched tape in control unit position the torches, tilt the work to the proper angle, and select the correct time and current for the weld.

In Shops Around the Country

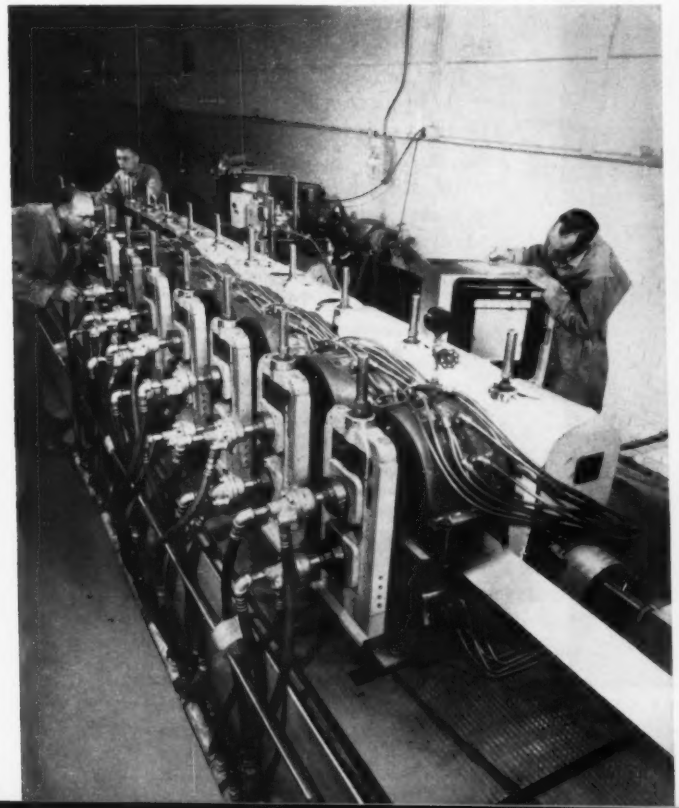
Camera highlights of some interesting operations performed in various metalworking plants throughout the nation

"MAGNET" HOLDS BRASS — Double-sided, pressure-sensitive tape solves holding problems in surface-grinding brass feed discs at the Heald Machine Co., Worcester, Mass. Use of the tape has increased production 300 per cent over previous method of holding the discs with steel strips on a magnetic chuck. Carbide cutters are also being held in the same manner for surface grinding the clearance angles.

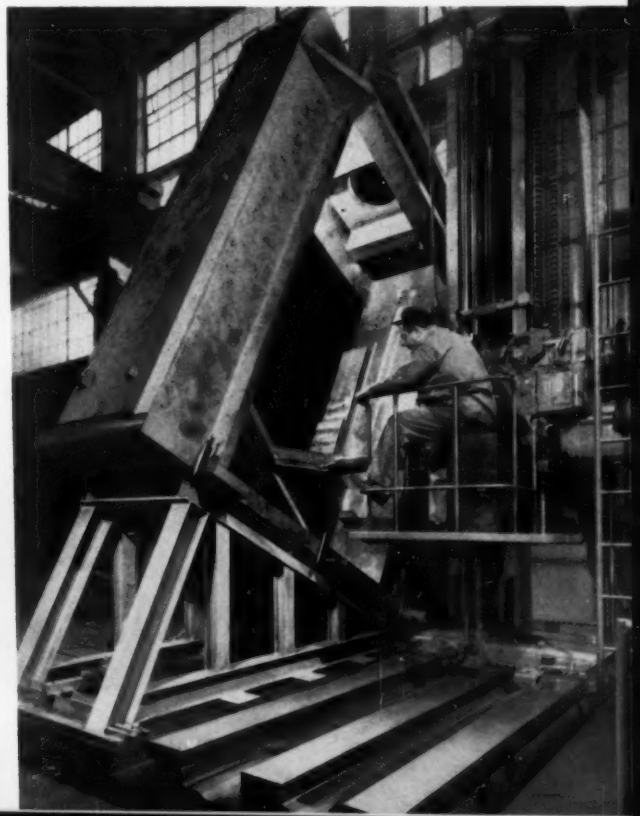
SHOOTING GALLERY — Ruggedness of turbine-blade construction is tested dramatically with bullets of ice shot by compressed air in a laboratory of the Garrett Corporation's AiResearch Mfg. Division, Los Angeles. Unit under test is a turbocompressor, part of a pressurization system being produced for jet airliners. Icing conditions sometimes encountered in frigid weather aloft are simulated by the battering of the ice bullets on the unit.



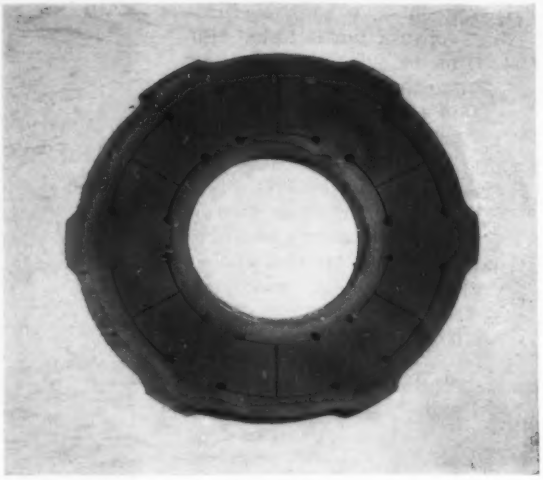
HOT ROLL — Titanium high-strength alloy strip is rolled into tubing on this modified Yoder mill at Boeing Airplane Co., Seattle. Each roll stand is enclosed by a furnace having eighteen gas burners. In operation, the rolls glow a dull red, but water circulating through hollow shafts keeps bearings running cool. The fuel consists of premixed propane gas, and heats rolls to correct forming temperature in one hour.



SHEAR CUT — A shear blade frame for a large scrap cutter is machined on a Giddings & Lewis horizontal boring mill at Baker Perkins, Inc., Saginaw, Mich. To end-mill two V-shaped surfaces, the 27-ton frame is held at a 25-degree tilt. One of ten units under construction, the frame will contain a blade capable of cutting a 20-inch steel I-beam. Fabricating the frame took three hundred hours of welding time.

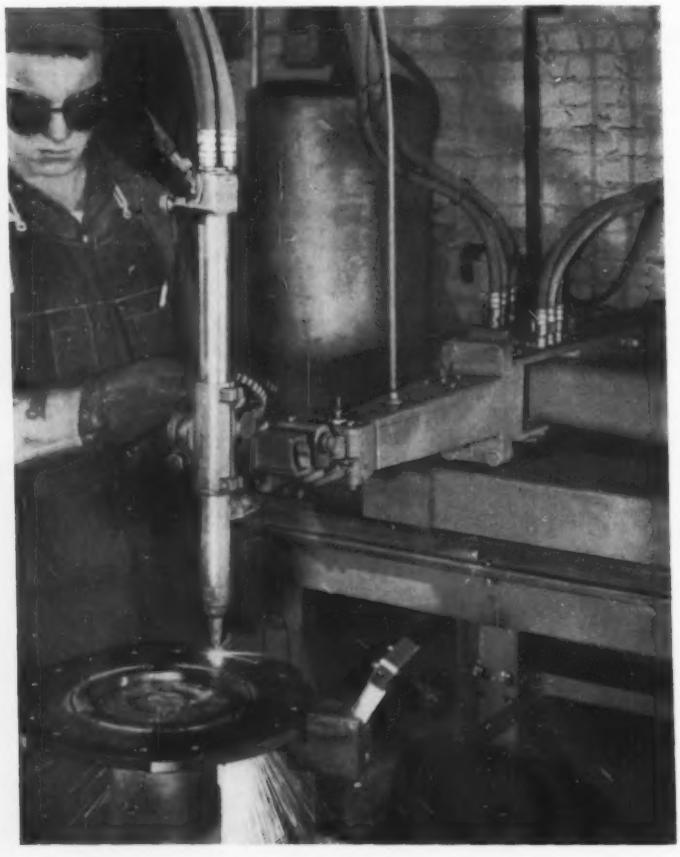


Flame-Cutting Speeds Production of Jet Aircraft Part



BRAKE ROTORS for jet aircraft, formerly produced in six segments, are now made in one piece with the aid of oxy-acetylene flame-cutting. A feature of the method adopted by Alpha Industries, Logansport, Ind., to manufacture these rotors is the flame-cutting of eighteen accurate slots 1/16 inch wide in a steel blank 7/16 inch thick. A Linde Oxweld flame-cutting machine, a rotary positioner, and twin torches are used to produce the work-piece. The flame-cut part, prior to finishing operations, is illustrated in Fig. 1.

In the new production sequence, two rotor profiles are simultaneously cut by two torches on an Oxweld flame-cutting machine from 7/16-inch thick steel plate. This machine mounts twin Oxweld cutting torches side by side on a special 90-degree adapter bracket. The torches are guided by magnetic tracing equipment to assure maximum accuracy along the 18-inch inner and 42-inch outer edge surfaces of the rotor blank.



After annealing, twenty-four holes are drilled in each blank. The drilled blanks are then placed on a rotating positioner, Fig. 2, and the flame-cutting machine and a torch are used to cut the accurate slots. The torch cuts 36 inches of curved slots and 12 inches of radial slots —a total length of 48 inches of exact, 1/16-inch wide slot per rotor. The time required to produce these slots is only eleven minutes. Following the slot-cutting operation, the rotors are again annealed and several machining operations and heat-treatment are performed to complete the brake rotor.

Fig. 1. (Above) The brake rotor after the slots are flame-cut. Holes at ends of slots are drilled. Several additional operations are necessary to complete the part.

Fig. 2. (Left) Slots 1/16 inch wide are accurately cut in a 7/16-inch thick steel blank for work-piece seen in Fig. 1. Torch is maneuvered on a flame-cutting machine, and part is held on a rotary work-positioner.

MATERIALS

The properties and new applications of materials used in the mechanical industries

Stress-Stabilized, Free-Machining Bar Steel for Wear-Resistant Parts

A high-strength, stress-stabilized, free-machining, cold-finished bar steel called "Jalcase 100" has been announced by Jones & Laughlin Steel Corporation, 3 Gateway Center, Pittsburgh 30, Pa. Use of this steel in the production of wear-resistant parts eliminates the need, in most cases, for heat-treatment during fabrication.

This steel has a guaranteed minimum yield strength of 105,000 psi in round sizes 1 1/2 inches in diameter and smaller, 100,000 psi for over 1 1/2 to 3 inches in diameter and 90,000 psi for diameters over 3 inches. It has a guaranteed minimum hardness of 248 Brinell in round sizes up to and including 1 1/2 inches and 241 Brinell for larger sizes. It has a chemical analysis equivalent to AISI Grade C-1144 and a machinability index of 82 per cent.

Cork Gasketing Material that Eliminates Seepage and Leakage

The development of a cork gasketing material designed to eliminate seepage and leakage of fluids and gases has been announced by the Armstrong Cork Co., Lancaster, Pa. Called "Uniphase Cork," the material combines impermeability, conformability, and chemical inertness. It is made with a continuous-phase, elastomeric binder that surrounds and embeds the cork particles. The material is resistant to fungus attack and is ozone-resistant. It seals at flange pressures as low as 100 psi as well as those as high as 4000 psi. At the higher pressure the material does not crush or extrude.

Ductile High-Strength Aluminum that Resists Stress Corrosion

A ductile, high-strength aluminum sand-casting alloy that exhibits a high resistance to stress corrosion and retains ductility during natural aging has been announced by Aluminum Company of America, Room 745, Alcoa Bldg., Pittsburgh 19, Pa. Called "Alcoa Alloy X250-T4," this casting alloy was developed for aircraft structures; construction or mechanical equipment subject to impact loads; and equipment for the dairy, food, and chemical industries. It was developed to replace alloy 220-T4, whose minimum tensile properties it exhibits.

Clear Anodize for Magnesium Facilitates Color Range

A clear anodic coating called "Dow 17-40 volt" anodic treatment for magnesium alloys has been developed by the Dow Chemical Co., Midland, Mich. This anodize is used under a lacquer or varnish which may be tinted with commercial dyestuffs. The resulting colors have good permanence and are not washed out by detergents.

The anodic treatment consists of a buffing operation, an alkaline-immersion cleaning operation, an immersion in an anodizing bath, a rinse and drying, a lacquer- or varnish-spraying operation, and finally a drying operation. The treatment may be applied to all forms of magnesium, such as sheet, extrusions, die-castings, sand castings, and forgings.

High Yield and Tensile Strengths Achieved in Nickel-Silicon Bronze

A corrosion-resistant nickel-silicon bronze alloy which has both a high yield and a high tensile strength even at elevated temperatures has been developed by Chase Brass & Copper Co., Waterbury, Conn. The alloy, called "Chase Silnic Bronze," is age-hardenable and is available in soft, cold-forming (solution annealed and drawn), and hard tempers. In the cold-forming temper it may be severely cold-worked. Subsequent age-hardening gives high strength, hardness, and conductivity to this alloy. It will not age-harden spontaneously at storage temperatures.

When purchased in the hard temper the alloy can be machined or given moderate cold-working without further treatment. It is free from silicon segregation and has uniform distribution of strength and hardness through its entire cross-

section with identical properties for the whole range of sizes. It is not subject to fire-cracking during processing, and has a high resistance to both general and stress corrosion.

Silnic Bronze is composed of 97.5 per cent copper, 1.9 per cent nickel, and 0.6 per cent silicon. It is available in a variety of cross-sections and dimensions in straight lengths of rod and bar; and coils of round, rectangular, and square rolled and drawn wire. Typical tensile strength is 100,000 psi and typical yield strength is 88,000 psi. It has an elongation of 22 per cent in two inches.

Coating that Withstands Boring, Turning, Tooling, and Milling

A metal coating, called "Dunal," introduced by J. Landau & Co., Inc., Carlstadt, N. J., facilitates the production of precision parts by permitting the units to be coated first before being machined. The coating will not crack under extreme pressure or heat, is not affected by alkalies and acids, and can withstand impact. The part to be coated may be dipped or sprayed, then baked. The resultant coating is permanent and durable. Uses include refrigerators, pumps, washing machines, and automobile and aircraft parts.

Tungsten-Carbide Powder for Spray Hard-Surfacing

A hard-surfacing powder with a high tungsten-carbide content that can be applied to steel parts by well-known metal spraying techniques has been announced by Kennametal Inc., Latrobe, Pa. Called "Kenspray," the powder is said to produce a hard surface that possesses properties closely approaching the maximum-wear qualities of Kennametal's cemented tungsten carbides.

Irregular shapes and flat surfaces can be coated easily. Surface coatings from 0.010 inch to 0.090 inch in thickness can be obtained. Steel parts can be coated with hand-held or mechanically held spraying equipment. Once applied, the coating is heated by an oxy-acetylene torch or in a furnace, to fuse the hard-surfacing deposit to the base metal. Because of their high hardness, Kenspray surfaces cannot be machined, but must be ground with diamond or silicon-carbide wheels when close tolerances are required.

Air-Hardening Weldable Martensitic Alloy for Highly Stressed Parts

An air-hardening, weldable, and fully martensitic alloy has been developed by the Carpenter Steel Co., Reading, Pa., to meet the need for a metal that can be used for highly stressed parts at temperatures up to 1050 degrees F., where joining is a problem. Called "Carpenter 404 alloy," it is free from weld cracking without preheating or postheating. After welding it can be stress-relieved or annealed and then cold-worked. It is essentially a 12 per cent chromium, 1 1/2 per cent nickel composition having relatively high tensile strength and good ductility. In the annealed condition, it can be easily blanked, drawn, formed, or cold-headed. It machines in both the treated and annealed conditions.

The alloy offers resistance against a wide range

This spray hard-surfacing operation uses a powder known as Kenspray to provide surfaces with properties that approach the wear-resistant quality of Kennametal cemented tungsten carbides. The inset shows parts completely hard-surfaced.

of corrosives, as well as resistance to scaling at elevated temperatures. It can be used for continuous service up to about 1200 degrees F. This steel is available in the form of forging billets; hot-rolled, cold-drawn, and ground bars; forgings; wire; wire rods; and strip. Uses include steam-turbine buckets, blades, and bucket covers, as well as "casting in" assemblies, such as turbine diaphragms.

Lithium Silver-Brazing Alloy for Stainless Steel

A lithium-containing, silver-brazing alloy which will join such metals as precipitation-hardening stainless steels and other high-temperature aircraft steels has been announced by the American Silver Co., 36-07 Prince St., Flushing 54, N. Y. Designated "Fluxless Nu-Braze No. 0070" (containing lithium), it has a melting range of 1435 degrees F. (solidus) to 1635 degrees F. (liquidus). It contains 0.2 per cent lithium, 92.5 per cent silver, with the balance of copper. It is used for structural parts operating in temperatures up to 900 degrees F., such as aircraft honeycomb structures and heat exchangers.

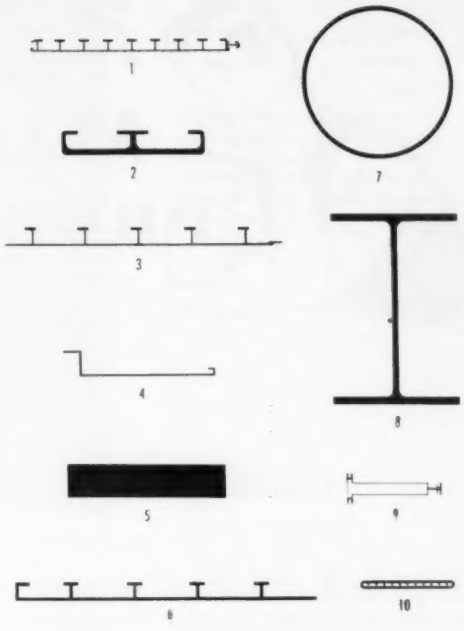
Broad Temperature Range Polymer for Packings, Seals, and Gaskets

"Viton," a broad temperature range polymer developed by DuPont which has proved successful in military aircraft and missile applications, is now being used by the Garlock Packing Co., 429 Main St., Palmyra, N. Y., in the manufacture of packings, seals, and gaskets. The durometer hardness of their packings ranges from 60 to 90.

This material may be used in service with oils and solvents at temperatures over 400 degrees F. It is highly resistant to ozone and weather deterioration. It will give good performance when exposed to dry heat, retaining its useful elasticity for more than 2400 hours at 400 degrees F. and 1000 hours at 450 degrees F. It resists attack from acids, bases, and many organic solvents, and also has good resistance to compression set.

Availability of Large Aluminum Shapes Aids Structural Designers

A large line of aluminum shapes for use as structural components for transportation equipment, building and architectural sections, bridges, aircraft and missiles, and tubes for atomic-energy installations has been announced by Harvey Aluminum, 9200 S. Western Ave., Torrance, Calif. The shapes, which include tube; integrally stiffened panels; stepped extrusions; structural sections such as I-beams, H-beams, channels, angles, tees, and zees; bar; rod; semi-hollow shapes; hollow and solid shapes, can be used to replace sections now being assembled from smaller components. They are available in lengths up to 110 feet, and wherever a heat-treated material is required in lengths up to 80 feet.



These typical cross-sections of extruded aluminum shapes from Harvey Aluminum make available to the structural designer components for transportation equipment, buildings, and bridges.

Easily Formable High-Strength Elevated-Temperature Nickel Alloy

The availability of an alloy in sheet or other wrought forms for use in a temperature range of 1200 to 1800 degrees F. has been announced by Cannon-Muskegon Corporation, 2875 Lincoln St., Muskegon, Mich. The alloy, called "Rene 41" and produced under vacuum-melting conditions, possesses excellent formability characteristics and is readily machinable. Drawing, bending, spinning, and other conventional shaping methods can be used in its forming.

The material has an ultimate tensile strength of 18,000 psi at 1000 degrees F., 140,000 psi at 1400 degrees F., and 40,000 psi at 1800 degrees F. It has a yield strength (0.2 per cent offset) of 135,000 psi at 1000 degrees F., 115,000 psi at 1400 degrees F., and 35,000 psi at 1800 degrees F.

The alloy exhibits good resistance to oxidation and is available in sheet stock, as rolled or polished, in sizes up to 48 by 120 inches and in thicknesses down to 0.010 inch; in wire (including welding wire); and in wrought bar stock.

MACHINERY'S PROBLEM CLINIC

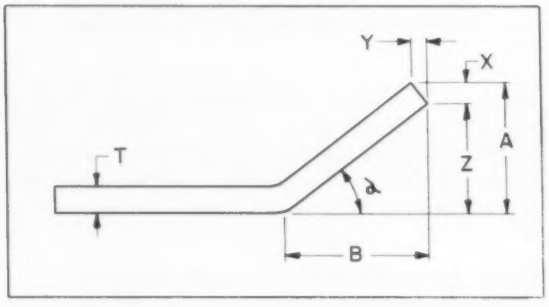
Mathematical problems in shop work and tool design submitted by readers of MACHINERY

Edited by HENRY H. RYFFEL

Calculating Angle α from Dimensions *A*, *B*, and *T*

BERNARD PACKER, Shaker Heights, Ohio

The drawing for the bent work-piece shown in the accompanying diagram specified the angle α by means of dimensions *A*, *B*, and *T*.



Angle α is fixed by dimensions (A), (B), and (T).

When it became necessary to determine angle α in degrees it was found that the problem could not be laid out on the drawing by exact location of connecting points. The designer then resorted to the following trial-and-error procedure.

SOLUTION:

1. $Z = A - T \cos \alpha$

2. $\tan \alpha = \dfrac{Z}{B}$

$= \dfrac{A - T \cos \alpha}{B}$

3. Rearranging (2),

$$\tan \alpha + \frac{T}{B} \cos \alpha = \frac{A}{B}$$

This equation is now solved by trial and error as illustrated in the following example.

Example: $A = 10$ inches, $B = 10$ inches, and $T = 1$ inch. Using Equation (3),

$$\tan \alpha + \frac{1}{10} \cos \alpha = \frac{10}{10}$$

$$\tan \alpha + 0.1 \cos \alpha = 1$$

Running down through the tangent and cosine columns of a table of trigonometrical functions, it is found that for $42°49'$ $\tan 42°49' = 0.92655$ and $\cos 42°49' = 0.73353$. Trying these, $0.92655 + 0.1 \times 0.73353 = 0.9999$ which is close enough to 1. Therefore the angle α may be taken to be $42°49'$.

Comment on the November Clinic

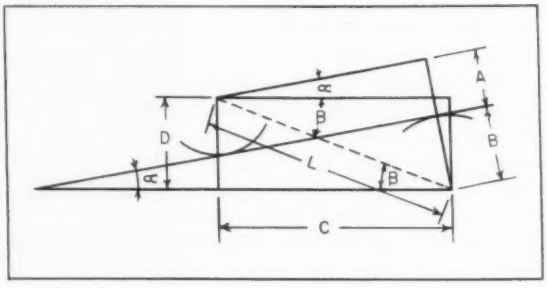
Quite a number of readers have pointed out that a shorter solution of the problem, "Angle of Tangent Between Two Radii" could have been obtained by using the trigonometric formula for the sine of the sum of two angles in Step 3 as follows:

1. $\cot \beta = \dfrac{C}{D}$

2. $L = C \sec \beta$

3. $\sin (\alpha + \beta) = \dfrac{A + B}{L} = \dfrac{(A + B) \cos \beta}{C}$

4. $\alpha = (\alpha + \beta) - \beta$



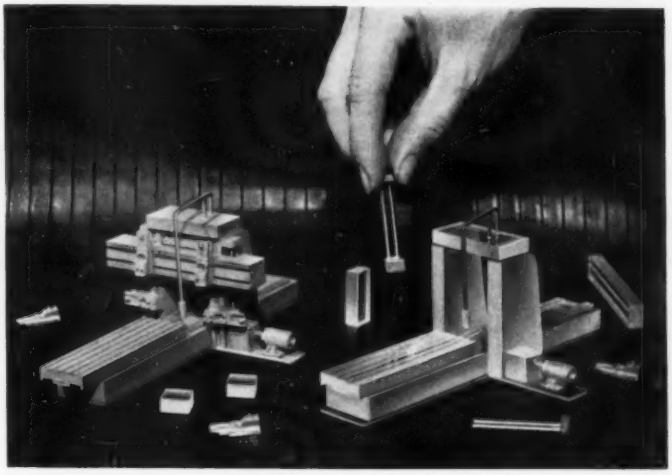
X-rayed electronic components encased in foam plastic being inspected remotely by closed-circuit television. New image-intensification system permits viewing in normal light.

Image Intensification Aids Inspection by X-Ray

An X-ray image-intensification system, called "TVX," that permits product inspection on a television type screen has been demonstrated by the General Electric Co. The image produced is claimed to be 10,000 times brighter than that obtained on a conventional fluoroscope screen. Unlike ordinary fluoroscopic inspection, which requires the inspector to work in a darkened area and then for only relative short periods of time, the new system is bright enough for easy viewing in normally lighted areas. The monitor provides the product inspector with an image which is electronically variable from one-half to three times the size of the original object.

Since the system allows product inspection with up to 1400 feet distance between monitor and camera, both the monitor and the inspector can be located remote from any X-ray radiation. This permits the safe use of any X-ray intensity necessary for adequate penetration up to the limit of the associated X-ray generator. Basically, the system consists of three units: an X-ray sensitive camera, a control unit, and a viewing monitor. Key to the image-intensification system is a new X-ray-sensitive camera tube which allows direct transfer of X-ray energy to electron energy capable of being displayed on a television monitor. In the illustration, the inspector is checking electronic components encased in foam plastic. The area of the component assembly seen on the 12-inch screen is enlarged and contains both resistors and electronic tubes.

These miniature planers are part of a kit of three-dimensional machine tool models used in making plant layouts. The kits, made by Scott Industries, Inc., Olean, N. Y., also include scale models of lathes, milling machines, drill presses, office equipment, etc. Such related items as motors, pipe, and fittings are available. The kits come unassembled and unpainted, and are reasonably priced. A catalogue of parts—"Designing in 3-D"—is available from the manufacturer.



LATEST DEVELOPMENTS

Machine tools, unit mechanisms, machine parts and

Monarch Ultra-Precision Contouring Lathe

A chucking type lathe designed for outside and inside contour tracing to ultra-precision tolerances has been announced by the Monarch Machine Tool Co., Sidney, Ohio. This Series 180 lathe of completely new design is intended for outside and inside diameter machining of thin-wall spherical and related-shape workpieces. It has a diameter range of from 5 to 15 inches.

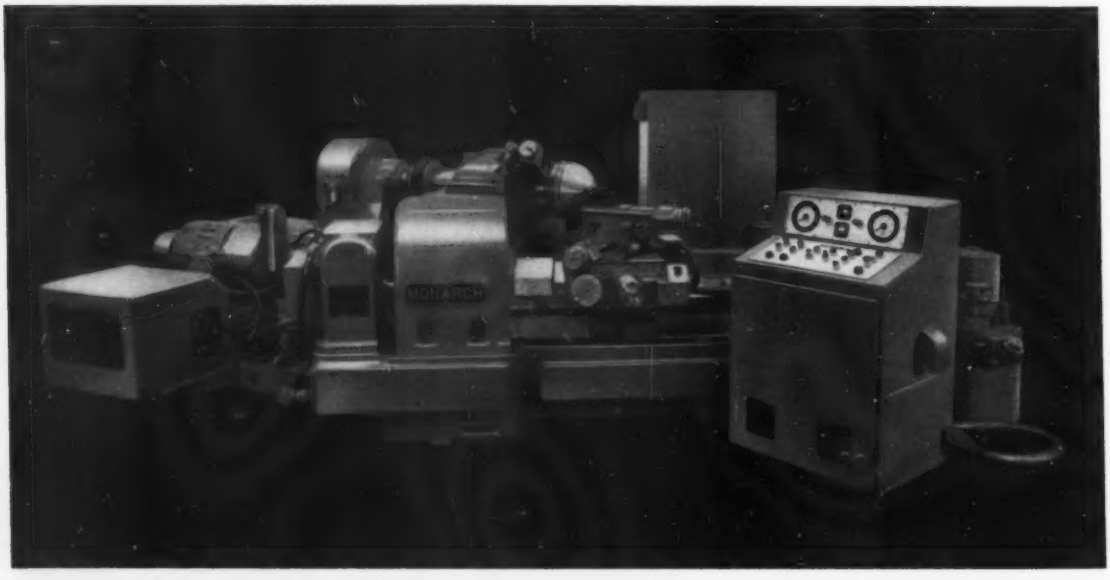
The spindle is set at an angle of 30 degrees to the bed axis in the horizontal plane. Runout at the nose is less than 25 millionths of an inch. The direct-current motor drive is connected with the spindle by a flexible coupling and provides infinitely variable speeds from 8 1/2 to 1000 rpm. This drive eliminates the transmission of vibration from the drive to the bed. It also provides for a constant surface cutting speed over a 6 to 1 ratio. The bearing lubricant is refrigeration-cooled to keep the spindle substantially at room temperature.

Bedways are flame-hardened and precision ground. The cross-slide moves on large, pre-loaded steel balls to minimize friction. Two adjusting slides permit tool adjustment, both parallel to and at right angles to the spindle axis. An electrohydraulic tracing system of new design controls the slide position within 20 millionths of an inch while tracing around a template. This is the total accumulated error from the tracer stylus to the tool point. The tracer head is mounted directly on the tracer-slide while the template table is located below the carriage between the bedways. A separately cooled hydraulic tank for powering the tracer is floor mounted.

Because high-precision results depend to a considerable extent on constant, low coolant temperature, water cooling coils are used to hold the coolant temperature within plus or minus 5 degrees. Carriage feed is powered by a separate, infinitely variable motor drive through a multiple feed range gear-box. The complete feed range is from 0.008 inch to 7.5 inches per minute. The feed-screw is located between the bedways to prevent yaw, which might result from feeding forces. Dogs and limit switches provide an automatic work cycle.

Electrical control of the machine is from a console which may be located in any position that is convenient for the operator. To assure ultra-close tolerance performance, the lathe is built and tested in a temperature-controlled area. Of course, it must also be used in such an area to obtain the highest precision.

Circle Item 565 on postcard, page 171

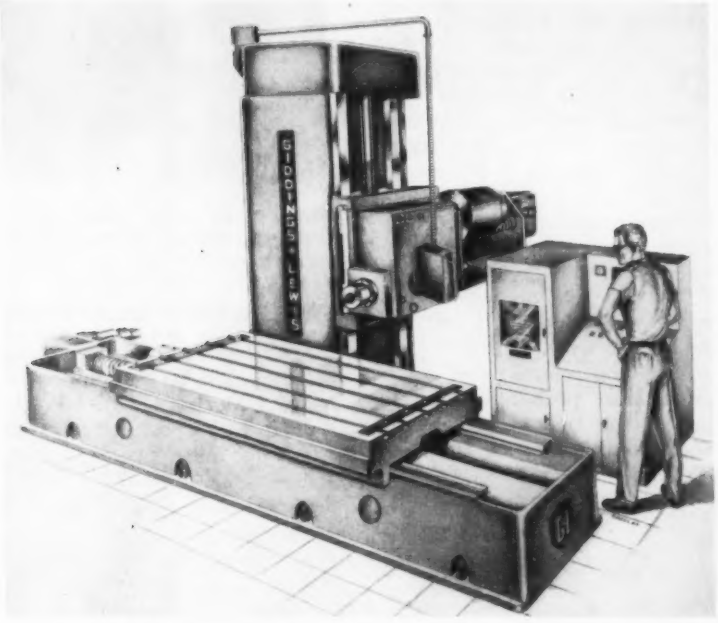


Ultra-precision contouring lathe for internal and external work announced by Monarch Machine Tool Co.

IN SHOP EQUIPMENT

material-handling appliances recently introduced

Edited by Freeman C. Duston



Giddings & Lewis numerically controlled DiMil contour milling machine

DiMil Numerically Controlled Contour Milling Machine

A numerically controlled die-sinker called the DiMil, developed by the Giddings & Lewis Machine Tool Co., Fond du Lac, Wis., is claimed to be the first equipment of this kind to produce large working dies. The first of such dies ever machined under numerical control is said to have been produced with a prototype of this machine in about half the time required by conventional methods. For this work the DiMil die-sinker was operated by a Giddings & Lewis Numericord continuous-path, magnetic tape-control system.

A large hammer die, for example, was produced with a 43 per cent reduction in manufacturing time over that required by the template method. "Manufacturing" included complete programming and recording of the tape. Actual machining time was reduced 67 per cent. The time spent at the bench and in polishing the dies was cut 62 per cent, due to the improved accuracy and finish obtained. When a duplicate of the first die was machined, the savings mounted up to a 77 per cent reduction in total manufacturing time.

Under tape control, a DiMil numerically controlled milling machine will generate any defined surface. Thus, it can be programmed for a wide range of profile milling, including dies, molds, cams, templates, and many prototype and production parts. Manual operation (push-button change-over) also is provided for general-purpose utilization of the machine. Most work can be handled on one of the six table type models, the smallest of which has a 36- by 48-inch working surface. The design has a moving table with a fixed column.

Large work, up to the biggest dies in use, can be handled on floor type machines. On these, the column, carrying the head, moves on a runway and the work-piece is fixed.

Both table and floor type models are available with 10- or 20-hp heads. All machines have quill type milling heads with thirty-eight spindle speeds ranging from 10 to 1780 rpm. An 18-inch head traverse and 10-inch quill extension accommodate dies having appreciable depth.

A decimal readout system is available for all three motions to give an exact indication of cutter position. Horsepower and feed-rate meters insure that all cuts are taken at maximum efficiency and provide a guide for the operator as to the condition of tool sharpness. To insure that tools are replaced when necessary, tool change is also programmed.

Tapes are stored for repeated use, just as are templates and models. However, with tape, storage space requirements and maintenance are negligible. Also, tapes can be duplicated in a fraction of the time required for templates and models. Tape-controlled DiMil machines have the flexibility required to meet a variety of conditions. For example, to rework the draft on a die, it is not necessary to produce a new tape. Simply changing to a cutter with a different draft angle will do the job, because the tape describes the path through which center of the tool moves. Another feature of tape control is found in machining forging dies. Shrink allowance can be automatically programmed.

The three basic steps required for the production of parts by

Numericord control consist of: (1) processing or programming; (2) recording the magnetic tape; and (3) performing the machining operations. Once the programming data is prepared, it is permanently available so that it need never be repeated to duplicate a work-piece.

Circle Item 566 on postcard, page 171

Snyder Automated Transfer Machine for Processing Aluminum Pistons

A special, fully automated, in-line transfer machine equipped to mill die-cast aluminum pistons to precise weight specifications at the rate of 600 per hour has been developed by the Snyder Tool & Engineering Co., Detroit, Mich. This is essentially an electrically controlled, hydraulically operated unit utilizing a rotating, finger type transfer mechanism. It will consistently mill pistons to a precision weight tolerance of plus or minus 2 grams.

A variety of modern, fully automated devices are applied in carrying out the weigh and mill-to-weight operations on the pistons. These include devices for sensing and orientation of parts in process, automatic in-process gaging, static automation turnovers, and automatic machine shutdown if parts are not machined to the correct weight specification. A high rate of production is made possible by utilizing full automation techniques in combination with foolproof, static automation devices and a unique application of an electrically controlled, servo valve mechanism. This mechanism accurately positions a wedge stop for the milling cutter positioning without returning to a fixed reference point between machining operations.

The machine occupies a floor space approximately 12 feet long by 5 feet wide. It has a cycle push-button control panel as well as separate push-button control panels for both the weighing and milling segments. Hydraulic power for operating clamping, milling head, and transfer-bar mechanisms is provided by a separate unit. The milling cutter is driven by a 10-hp motor.

Circle Item 567 on postcard, page 171

Snyder fully automated in-line transfer type special machine that weighs and mills automotive pistons to precision weight specifications

Power press brake introduced by Niagara Machine & Tool Works

Niagara Power Press Brake

A versatile 15-ton power press brake has just been introduced by Niagara Machine & Tool Works, Buffalo, N. Y., bringing this company's line to seventy-six standard models with capacities ranging up to 900 tons. Like all Niagara press brakes, this model is capable of a variety of forming, bending, punching, blanking, and related operations. All driving parts are located inboard between housings for greater operating convenience, safety, and compactness.

Positive, instant ram control, enabling smooth and sensitive jogging, is assured by the heavy-duty, synchronized friction clutch and brake. Simple construction and complete accessibility permit quick, easy replacement of long-lasting, heavy-duty friction discs without the need for disassembly of the clutch.

Laminated non-metallic ways provide long service life by reducing wear to a minimum. Other important features include: movable foot treadle which can be positioned for greatest operator convenience; totally enclosed and silent worm-gear drive; built-in lubrication with all gears running in sealed oil baths; front-controlled, adjustable speed drive; anti-friction bearings for transmission gears, shafts, and flywheel; and main bearings provided with bronze bushings.

Circle Item 568 on postcard, page 171

Ingersoll Aluminum Billet Scalper

The duplex aluminum billet scalper, Fig. 1, built by the Ingersoll Milling Machine Co., Rockford, Ill., for the Reynolds Metals Co.'s plant at McCook, Ill., is the largest, most powerful, and most productive of the many scalpers built by the Ingersoll Co. It can process more than two million pounds of aluminum in an eight-hour shift, milling both faces of aluminum ingots measuring up to 204 inches long and ranging up to 6 feet wide and 2 feet thick. It has handling capacity for ingots weighing up to 25,000 pounds each.

The 84-inch diameter Ingersoll "Shear Clear" carbide face-milling cutters on this machine are second in size only to a 91-inch diameter Shear Clear cutter which Ingersoll furnished some years ago with an 800-hp scalper. When maximum stock conditions prevail at the highest feed rates, the machine pulls 2800 hp. In order to cut dry, a cutting speed of 15,000 feet per minute was adopted. While an ingot is being cut, uncompacted chips of the softer alloys come from the machine at a rate of 700 bushels per minute.

Ingots come to and leave the machine on powered roller conveyors. The fully automatic operating cycle begins as the ingot rolls onto an up-ending unit in front of the fixture. The ingot is loaded into the fixture, centered and clamped hydraulically, fed through the cutters, to the position shown in Fig. 2, where it is unloaded automatically. This process continues automatically, at a production rate of 30 ingots per hour, as long as the crane operator keeps the loading conveyor supplied. While the machine will continue to cycle indefinitely under normal conditions, all motions of the machine and handling equipment can be controlled individually from the operator's station. The fixture rail carrying the clamping cylinders, as well as the cutting heads and cutters, is adjustable by push-button controls to suit ingots that vary in width and thickness.

Elaborate provisions for the prevention of accidents or misuse of the machine are included in the control system. Hydraulic accumulators maintain pressure on the fixture clamps in the event of power failure. A mechanically activated clutch and spring-operated brake disconnect the table drive from the feed motor and arrest table motion independently of electric control if the table travels beyond limit-switch end stops. A fixture interlock prevents

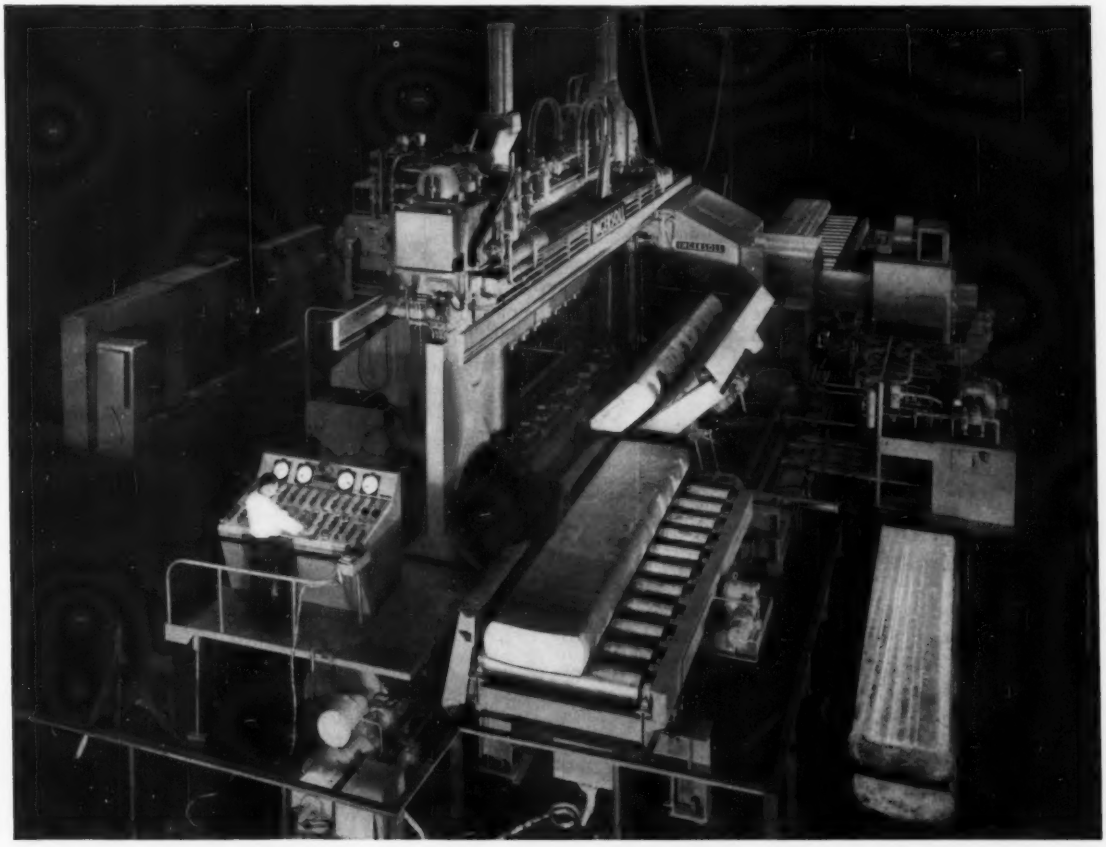


Fig. 1. Front view of Ingersoll scalper showing control panel, billet on way to loading station where preceding billet is being tilted into position before passing between two huge heads

operation of the machine if the ingot is not clamped.

The cycle stops if finished ingots are not removed in time from the unloading conveyor. A positive stop prevents adjusting the cutter into the fixture, and an interlock prevents starting the spindle drive motors when jog motors (used while changing cutter blades) are engaged. If the spindle bearing temperature exceeds a pre-set limit, a red warning light on the head goes on. The table feed rate is lowered or raised automatically when the load on drive motors exceeds or drops below a pre-set limit, as the case may be.

Circle Item 569 on postcard, page 171

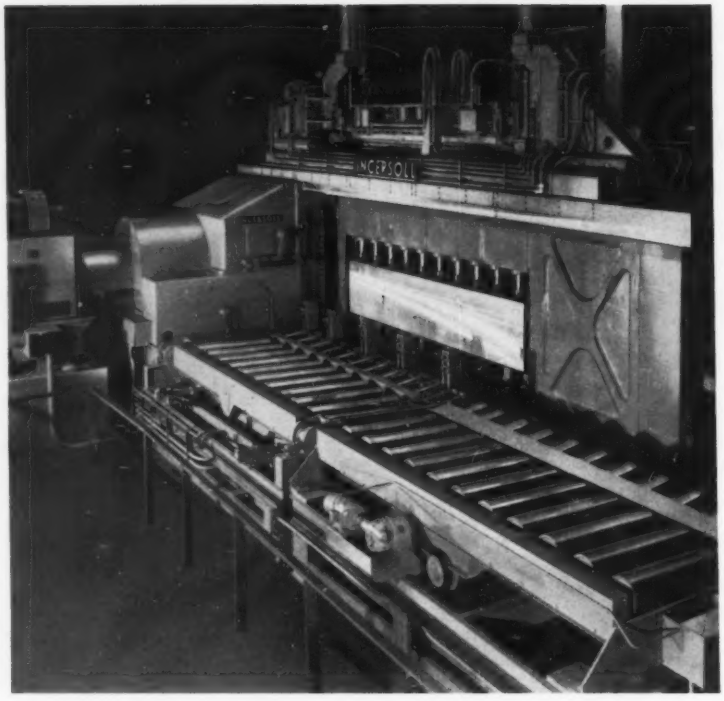


Fig. 2. Rear view of machine illustrated in Fig. 1, showing billet clamped in work carrier after being scalped on both sides

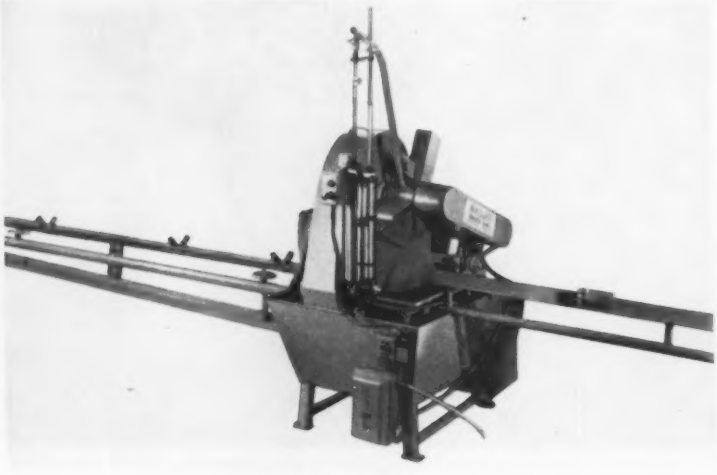
Wallace Modular Cutting Unit

A cut-machining unit in which clamping of the work, movement of the cutting head through the work, and flow of coolant automatically follow the pushing of a button has been added to the line of equipment made by the Wallace Supplies Mfg. Co., Chicago, Ill.

The rate of saw travel is infinitely variable to suit the wide range of materials the machine is capable of cutting. This easily set up unit can be had with work-aligning unit, shown on the left, and a positive, effective gage unit shown on the right in the illustration. The modular type cutting machine is available with 16-, 18-, and 20-inch wheel units.

The cutting capacities of the three sizes range from 4 1/2 inches outside diameter for tubing, 2 1/2 inches for bar stock, and 5-inch I-beams for the smallest machine to 6-inch tubing, 4-inch round bars, and 8-inch I-beams for the largest size machine. The three machines are powered by 7 1/2-, 10-, and 15-hp motors, respectively.

Circle Item 570 on postcard, page 171



Wallace cut-machining unit

Graphicraft Guide for Drawing Gears

An underlay drawing of a rack and twenty-one gear faces having six to forty-eight simplified teeth in isometric projection has been announced as a new drafting room aid by Graphicraft, P. O. Box 509, Westport, Conn. Gear faces of four diametral pitches—8, 12, 16, and 24—are included in the underlay drawing.

The tooth form is based on the rack of the American Standard 20-degree involute system. The aid is designed for use in drawing spur, helical, bevel, internal, herringbone, and worm gears, as well as worms, racks, splines, ratchets, and sprockets. The drawing is also adaptable to other circular forms having evenly spaced projections, such as cutters, pump rotors, turbines, and commutators. It may also be used for perspective projection.

Circle Item 571 on postcard, page 171

Heavy-Duty Roller Shear

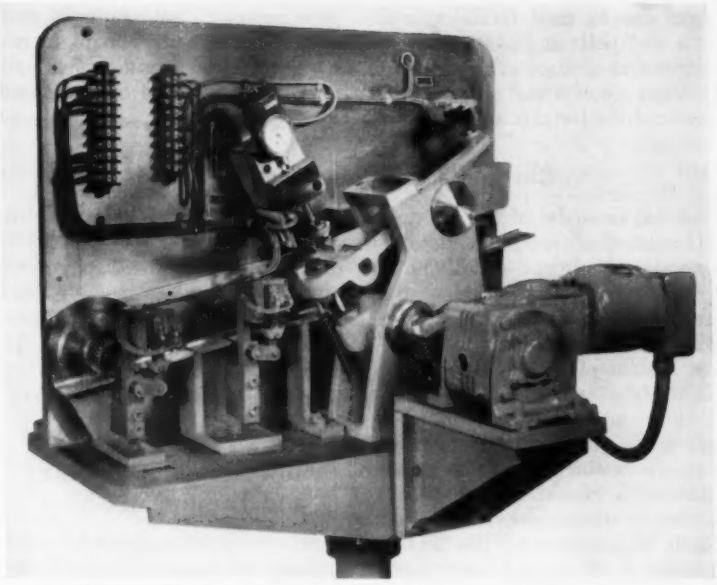
A heavy-duty type roller shear designed on a new working principle is now available from the Cosa Corporation, New York City. This machine is made by Schulze & Naumann, Germany, in five different models, providing shearing capacities for material up to 1 1/2 inches thick in cutting lengths up to 60 feet. The maximum deviation from a straight line of a cut 40 feet long is not more than 0.0125 inch.

Plates are sheared between a lower blade and an upper shearing roller, running along the lower blade at speeds up to 112 feet per minute. The extremely rigid, amply dimensioned guide way of the shearing carriage is designed to insure clean, accurate cuts.

The carriage, traveling alongside the bed, carries two shearing heads, one for straight and one for bevel cuts, with rapid changeover from one to the other. Almost any type of cut is possible. For example, the larger shears (1/2-inch capacity and up) can produce chamfered (Y-type) cuts for deep welding processes in one pass. Resulting cuts are ready for immediate welding without further preparation.

These roller shears can also be equipped with a large variety of powerful planing attachments which convert them into a combined shear and plate edge planer, and permit preparation of profiled edges or double vees.

Circle Item 572 on postcard, page 171



Red Ring automatic gear gaging and sorting machine that checks accuracy of gears having large integral flanges

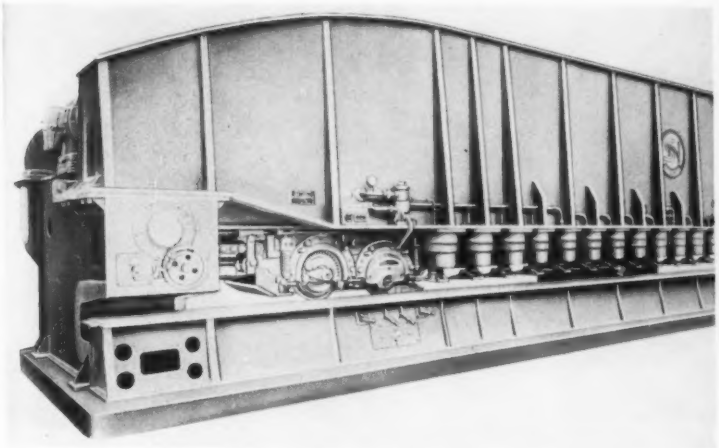
Red Ring Automatic Gear Gaging and Sorting Machine

A Red Ring automatic gear gaging and sorting machine that checks the accuracy of gears with large integral flanges is now available from National Broach & Machine Co., Detroit, Mich. This pedestal-mounted unit will check gears produced by hobbing, shaping, or shaving operations. It is designed to automatically inspect unwieldly gears having integral flanges which cannot be fed through feed chutes of conventional design.

The flanged gear rolls through the gage on a guide rail that supports the gear on the hub surface between the gear and the flange. Another guide rail behind the gear bears on the flange surface and keeps the gear upright until it is engaged by the master gear.

In the gage illustrated, the size of a helical gear having a large integral flange is checked automatically. One gear at a time rolls into mesh with a motor-driven, lower master gear that raises the gear from the lower rail for the precision electronic size-checking operation. The upper master gear, which is on a spring-loaded, pivoted-beam mechanism, squares up the gear as it passes between the master gears for the size check.

The amount of deflection of the upper master gear is accurately measured as the tested gear passes through to determine the size of the gear teeth. Gears of correct tooth size pass into the gage exit chute and onto the production line. Gears that are oversized or undersized cause individual trap doors in the exit chute to open, thus removing rejects from the exit chute and segregating them according to the type of size errors. A similar design of



Heavy-duty roller shear introduced by the Cosa Corporation

gage can be used to check both size and helix angle error simultaneously.

A unique overload clutch in the motor drive for the lower master gear serves to automatically correct any mis-mesh that might occur on initial contact, without imposing any stress on the gage.

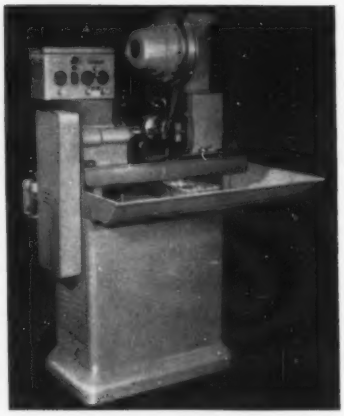
Circle Item 573 on postcard, page 171

Gardner Precision Disc Grinder

A larger model of the Gardner 2H series of precision double-opposed horizontal-spindle disc grinders has been added to the line of flat-surface grinding machines manufactured by the Gardner Machine Co., Beloit, Wis. The illustration shows a Gardner 2H40L 42-inch precision disc grinder with rotary carrier fixture equipment for grinding two parallel sides of valve plates 5.395 inches in diameter by 0.170 inch thick. This version of the 2H40L grinder is equipped with horizontal trough loader for feeding parts into the stations of the rotary carrier. It also has an automatic face-cut mechanism for progressive stock removal, a diamond dresser which is automatically actuated after a preselected number of parts have been ground, automatic size control, and an integral wet-grinding system.

The Gardner 2H40L grinder is available with 36- or 42-inch diameter abrasive discs, and with a variety of work-carrying fixtures for grinding metallic or nonmetallic work-pieces up to 18 inches in diameter.

Circle Item 574 on postcard, page 171



Automatic drilling and tapping machine announced by Snow Mfg. Co.

Snow Automatic Drilling and Tapping Machine

An automatic machine for rivet drilling and tapping has been announced by the Snow Mfg. Co., Bellwood, Ill. This equipment is basically a horizontal application of the same operating principles used in Snow vertical machines for drilling, tapping, and threading. The machine may be used with a hand-feed magazine for short runs, or with hopper feed for long runs. An automatic, air-operated cylinder clamps the part securely for drilling or tapping. A production rate of 500 to 3200 pieces per hour is easily obtained, depending on the hole size and material. Capacity varies from No. 72 drill (0.022 inch) to 3/8-inch drill with spindle speeds from 500 to 10,500 rpm. The tolerance on depth is held within 0.002 inch.

The outstanding feature of this machine is that it permits minimum tooling costs for each job.

Precision disc grinder announced by Gardner Machine Co.

For example, 0.081-inch holes (No. 46 drill) are being drilled through 1/2-inch thick material at the rate of 3000 per hour on the machine illustrated. The only tooling needed is the magazine and the insert jaws. Time required for change-over is less than ten minutes.

Circle Item 575 on postcard, page 171

Waterborg Scan-O-Matic Hydraulic Duplicating Attachment

The Waterborg Machine Co., Racine, Wis., has developed a Scan-O-Matic hydraulic duplicating attachment for milling machines which is adapted for sinking dies or molds, or making precision metal patterns. With the Scan-O-Matic automatic scanning system the tracing stylus automatically follows the contour of a master regardless of whether straight walls, angular, or curved surfaces are being cut or duplicated. Thus, the deflection of the stylus always remains the same, resulting in uniform and accurate cuts.

The lead-screws are used to actuate the milling machine knee, saddle, and table. Special, constant-torque hydraulic motors, made only by the builder of the attachment, provide the rotary power for operating the lead-screws. Adjustable stops, operable from either the motion of the table or the knee, trip the table-reversing valve at the end of each stroke. At the same time an indexing motor cross-feeds the work for a new cut. The cross-feed is adjustable in increments from 0.0025 to 0.150 inch.

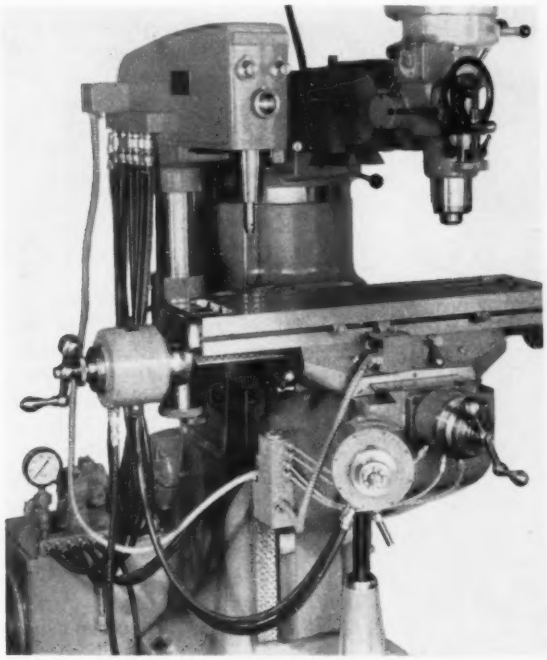
Because it is possible to actuate the reversing valve by a vertical as well as a horizontal motion, the stops can be set to operate the trip when the tracer strikes the wall of a cavity or a core. Thus, any wall-climbing action is eliminated. An adjustable depth stop regulates the depth of each consecutive cut.

Circle Item 576 on postcard, page 171

Rotoblast Table-Room for Cleaning Castings, Stampings, and Forgings

A 6-foot, Rotoblast table-room, designed for cleaning all types of work in jobbing foundries and plants requiring a flexible machine for a wide range of cleaning operations, has been introduced by the Pangborn Corporation, Hagerstown, Md. This equipment is capable of Rotoblasting castings, forgings, and stampings up to 72 inches in diameter by 36 inches high, and weighing up to 5000 pounds. The table is equipped with a cast labyrinth sealing system which makes the cabinet abrasive-tight without using rubber gaskets. The cabinet doors have been especially arranged for efficient loading.

A single overhead Rotoblast wheel, powered by a 30-hp motor, will throw 50,000 pounds of abrasive per hour. Featured for safety are power-operated guard-plates that are automatically positioned in front of the Rotoblast wheel when the motor is turned off. This prevents abrasive from striking the table. When the abrasive wheel is turned on again, the guard-plates retract to their original position. In addition, a safety switch automatically turns off the Rotoblast motor and the guard-



Scan-O-Matic hydraulic duplicating attachment announced by the Waterborg Machine Co.

Table-room for wide range of cleaning operations introduced by the Pangborn Corporation

plates go into position in front of the wheels when the doors of the table-room are opened. A self-contained, automatic elevator and extra-large capacity pneumatic separator continuously clean used abrasive for recirculation to the Rotoblast wheel.

Circle Item 577 on postcard, page 171

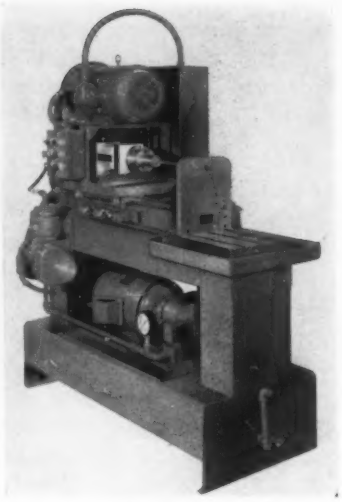
Gerrad Deep-Hole Drilling Machine

A machine for performing deep-hole drilling operations on commercial parts, commonly known as "gun-drilling," has been developed by the Gerrad Co., Hales Corners, Milwaukee Co., Wis. The base of this unit incorporates a large tank having settling and supply sections. The tank cover carries the cutting-fluid pump motor and the high-pressure pump. On the rear of the tank is mounted a coolant feed pump that feeds the high-pressure pump through a filter.

The base of the machine is mounted on the tank and supports the work fixture and base for the spindle slide. On the spindle slide is mounted one or more spindles and the bracket that supports the motor. The spindles are of the ball-bearing precision type with provision for feeding cutting fluid through them. They are capable of running at speeds from 250 to 10,000 rpm.

The spindle slide is operated by a screw from a pick-off feed-box with a range of from 0.3 inch to 40 inches per minute. The rapid traverse rate is 225 inches per minute in both directions. The cycle consists of: rapid advance of the tool to the work; dropping to feed rate and continuing through the work; returning to starting position at rapid traverse; and rapid stopping by application of brake. The feed and traverse are entirely electromechanically controlled by limit switches.

The coolant pump has a capacity of 10 gallons per minute at 1000 psi. A combination of variable sheave and pick-off gears permits any available feed to be easily obtained. The mechanical feed is so arranged that slippage will occur if a hard spot in the work is encountered by the drill. Thus the feed will slow down until the drill has passed through the hard spot. It will then return to normal speed without jumping or breaking drills.



Deep-hole or gun-drilling machine developed by the Gerrad Co.

Circle Item 578 on postcard, page 171

Micro-Path Control System Designed for Low-Cost Machine Tool Automation

A simplified system for machine tool control, called the "Micro-Path," which utilizes magnetic tape to store a pre-recorded program of machining operations, has been announced by Micro-Path Inc., a Division of Topp Industries Inc., Inglewood, Calif. This is claimed to be the first system combining point-to-point and continuous-path positioning control. It is said to represent a major development in the art by eliminating computer techniques and auxiliary equipment, as well as the need for specially trained technicians in the programming department.

The Micro-Path equipment can be installed on existing as well as on newly designed machines. Specific features, such as electronic backlash elimination, make possible accurate repeat applications. The self-contained Micro-Path contour table and console shown in Fig. 1 are specifically designed for continuous-path milling controlled from magnetic tape. They can be used with any vertical-spindle machine and supply all basic requirements for easy development of special, automated machines.

Various modular components are available that provide considerable flexibility in the application of the units to specific manu-

Fig. 1. (Left) Micro-Path console which houses electronic and tape-handling equipment. (Right) Contour table designed for continuous-path milling controlled from magnetic tape

facturing requirements. The "Pulservo Power Unit," Fig. 2, is a unique pulse-operated servomotor, which is controlled directly by the pulses read from the magnetic tape. It may be attached to the driven slide in any convenient manner through gear or timing-belt speed-reduction. Thus, the output of this unit can be given any desired feed rate.

One Pulservo is required for each motion to be controlled. Each unit is equipped with a positional control and speed-range selector switch which may be mounted at the most convenient location. It may be supplied in from 1/8- to 3-hp input ratings and will answer up to 6000 discrete steps per second, keeping the motion perfectly synchronized with commands.

The machine on which the Micro-Path system is installed can also serve as the programmer. For continuous-path programming it utilizes a stylus and special head in place of the usual cutter. Recording is fast and direct. Any path through which the slides are moved will be duplicated exactly on playback. Recordings can also be made on a special recording table independent of the machine on which actual cutting is performed. A positional control is supplied for each controlled axis.

To facilitate programming, the system is designed so that recording is carried on at 1/4 actual speed. The stylus programmer may be attached to the controlled machine in any convenient manner for making recordings from rough drawings, accurate drawings, precision-scribed layouts, simple sheet-metal templates, or actual parts. For years shops and experimental laboratory personnel have felt the need of an automatic system which would produce parts directly from rough engineering sketches. This is one of the outstanding operations performed by the Micro-Path system.

The precision, two-axis contour-milling table shown at the right, Fig. 1, is a self-contained unit designed specifically for continuous-path milling controlled from magnetic tape. Pulservos, one each for longitudinal and transverse axes, are built into the table and drive direct to the precision-ground ball lead-screws through appropriate gear reduction. Individual positional controls are provided for each axis, together with position readers and dial indicators. The main console, which houses the electronic and tape-handling equipment, is shown at the left, Fig. 2. The recorded information medium is an eleven-channel, 3/4-inch wide magnetic tape. The system utilizes a unique "fail-safe" check for each controlled axis. This checking device can be inserted in the program in as many places as desired. At a "fail-safe" point in the playback of the program, the system will automatically check its position relative to the program, and stop the operation if it is not "on program."

The cam shown in Fig. 3 was programmed with the tracing stylus from cardboard templates four times the actual work size. The total programming time for this part, after preparation of the 4 to 1 scale drawing, was three and one-half hours. Running time for the part was eighteen minutes.

Circle Item 579 on postcard, page 171

Fig. 2. (Left) Pulservo power unit of Micro-Path contour reproduction system for converting electrical impulses to rotary motion. Fig. 3. (Right) Cam produced by Micro-Path system using stylus programmer with cardboard templates four times the size of the work

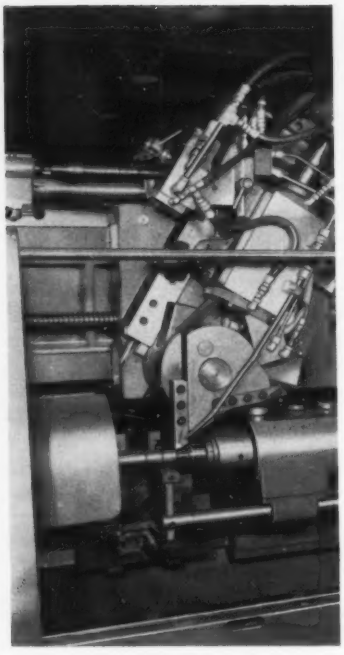


Fig. 1. (Left) Jones & Lamson automatic tracing lathe. Fig. 2. (Right) Close-up of work and tool on machine at left

Single-Spindle Fully Automatic Tracing Lathe

A rugged Model 30 tracer lathe, which can be combined with a variety of machine components to meet a wide range of specific turning requirements, is announced by the Jones & Lamson Machine Co., Springfield, Vt. This lathe can accommodate one of two tracing units. One unit takes a single tracing cut in a fully automatic cycle, while the other unit provides for two fully automatic tracing cuts with an indexing toolholder. Both units provide for feed changing during the cut.

One of two available headstocks may be selected. Both headstocks provide automatic speed shifting during a cut. One permits shifts between two speeds, while the other allows automatic shifting between four selected speeds. Rear slides for facing, forming, and turning are also available.

Other machine features are: extremely flexible controls which can be programmed from the operator's station; stylus and templates placed high, dry, and free from chips or coolants; large unobstructed area for manual or automatic loading; and provision for chip disposal.

General specifications are: diameter of swing over rails, 23 inches; and diameter swing over tracer-slide, 13 1/2 inches. Work from 1/2 inch to 8 inches in diameter can be handled. The maximum length of work between centers can be 24, 48, or 72 inches.

Circle Item 580 on postcard, page 171

Pneumatic Grinders for Wide Range of Applications

Thomas C. Wilson, Inc., Long Island City, N. Y., has announced the development of a new line of portable pneumatic grinders. Both lightweight, powerful horizontal grinders and high-speed die grinders are included. The horizontal grinders are applicable to a wide

Wilson pneumatic grinder being used to finish concave portion of casting

range of industrial operations such as grinding, buffing, and wire-wheel work. They have been designed for ease of handling and reduced operator fatigue in any metal-removing or metal-finishing operation. The accompanying illustration shows an operator grinding the concave portion of a casting with one of the new Wilson straight-handled, horizontal, portable grinders.

The new line includes portable grinders of various sizes and models with speeds ranging from 3100 to 12,000 rpm. Wheel sizes range from 3 to 8 inches in diameter. Lever, straight, or grip type handles may be specified.

High-speed, powerful die grinders designed to widen the scope of portable tool operations serve to speed up operations in tool and die shops, machine shops, pattern shops, or wherever filing, grinding, cutting, or polishing is done.

Special design features have been incorporated in these tools to assure well-balanced, vibration-free operation. Powerful three-bladed type air motors and high quality, air-cooled precision bearings are used. Quiet operation is made possible by a silenced exhaust at the rear of the tools. Both integral and remote type exhausts are available. Other features include cylinders that are hardened, ground, and honed, a push-pull throttle for regulating speeds, and true-running collets.

Circle Item 581 on postcard, page 171

Purox Starter Welding Set for Beginners

A Purox W-200 starter set has been introduced by the Linde Co., Division of Union Carbide Corporation, New York City. This set includes a Purox W-200 blowpipe with one welding head, a CW-200 cutting attachment and a cutting nozzle, two Prest-O-Lite regulators, Oxweld hose, goggles, and friction lighter. An enameled steel carrying case is furnished with the outfit. The head welds material up to 1/8 inch in thickness. There are other welding heads available that increase this range to 1/2 inch. The Purox CW-200 cutting attachment with nozzle cuts up to 2 inches.

Circle Item 582 on postcard, page 171

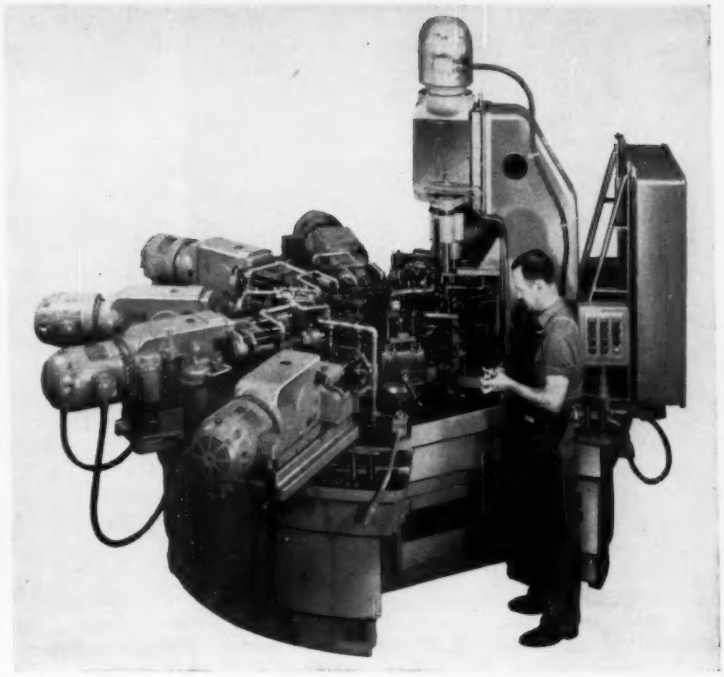


Fig. 1. Multiple-unit automatic for processing forgings for fuel injectors built by Kingsbury Machine Tool Corporation

Kingsbury Multiple-Unit Automatic for Processing Forgings for Fuel Injectors

The Kingsbury Machine Tool Corporation, Keene, N. H., has brought out a multiple-unit automatic machine, Fig. 1, which performs fourteen operations on forgings for fuel injectors (Fig. 2) in two chuckings of the work. Eight units end-mill, drill, ream, countersink, spot-face, and counterbore these forgings at a gross rate of 190 parts per hour. To meet this production rate, each unit has been designed to work on two parts at a time.

A 30-inch index-table holds five sets of double-chucking work fixtures equipped for manual clamping. For the first chucking in the right fixture the stems rest horizontally in vees and are clamped down. The wide ends of the blocks are down and nest between locator blocks. For the second chucking in the left fixture, the stems are located vertically as shown in the view to the right, Fig. 2. The two holes that are reamed in the first chucking fit over two pins. Two equalizing levers are provided to clamp the part down.

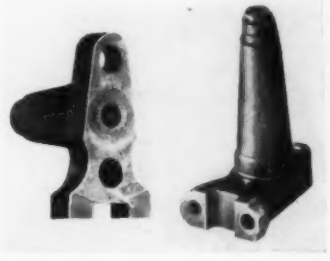


Fig. 2. Forgings for fuel injectors processed on machine shown in Fig. 1

While the operator changes four parts at the loading station, the units operate on sixteen parts at four work stations. In the first chucking two units end-mill two places for clearance. One unit drills two holes and another unit combination reams and countersinks them. In the second chucking the vertical unit countersinks the backs of these two holes. Three horizontal units drill, spot-face, and counterbore two more holes. Bushings guide all tools on the horizontal units.

Circle Item 583 on postcard, page 171

Rockford Hydraulic Swarfing Machine

A machine for swarfing the joining edges of parts or sub-assemblies having compound angle surfaces is announced by the Rockford Machine Tool Co., Rockford, Ill. This unit is especially designed for "warp" or "twist" milling (swarfing) the edges of aircraft and guided-missile parts, or similar work to obtain accurately mating surfaces. It combines the versatility and efficiency of hydraulic drive with the speed and ease of manual stylus control. Many "fail-safe" features serve to protect the operator and prevent costly work spoilage.

The swarfing head-slide with square-sectioned arc ways is bolted to the face of the duplicator slide. A swarfing saddle is moved on these arc ways by a trunnion-mounted cylinder. An electronic, single-axis tracer is mounted on adjustable slides on the left-hand column. The tracer stylus is positioned by a thin template held on support brackets.

The stylus converts the mechanical information received from the template to an electrical command signal. The electrical energy thus obtained is used to position an electrohydraulic servo valve which controls the flow of oil to the cylinder. A second electronic tracer located on the swarfing saddle feeds back electrical information to the servo valve to maintain accurate angular positioning.

A device incorporated in the upper arc way locks the head in a neutral position when the swarfing motion is not in use. This motion may be used simultaneously with any combination of vertical, transverse, or longitudinal movement, without any template compensation.

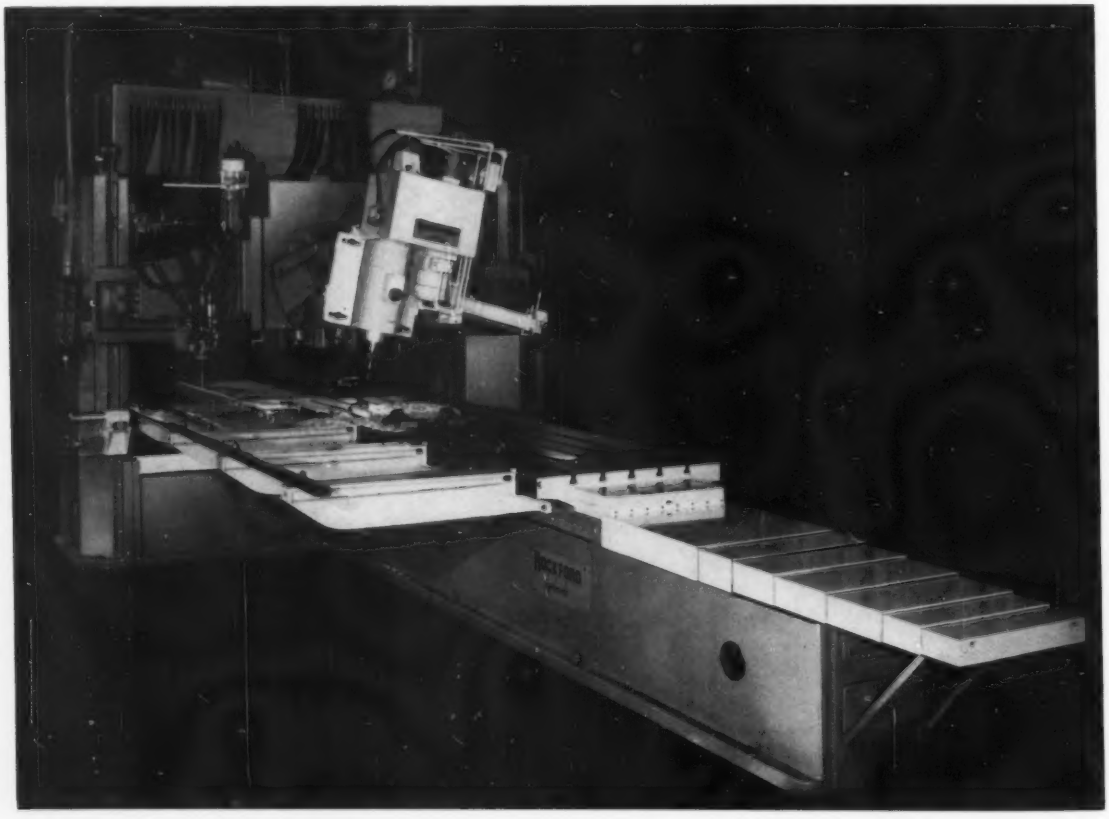
Longitudinal, transverse, and vertical movements are transferred from full-size wood, plaster, plastic, or metal full-form masters or templates to the milling cutter through the use of simple, manual, stylus control.

The machine has two valves: a three-dimensional tracer valve mounted on an adjustable slide to provide longitudinal, cross, and vertical adjustments for varying the relationship between the cutter and the stylus; and a servo valve arranged with a four-position turret stop for variable depth control in 360-degree contour operations. A button on the control pendent selects the valve to be used.

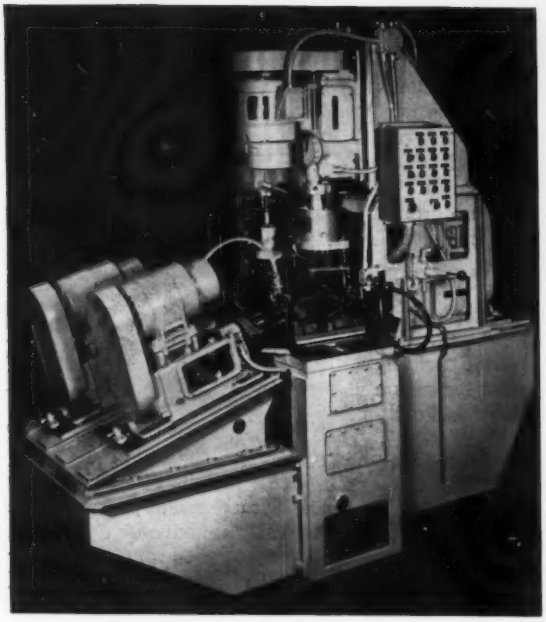
The tracer head is of fully balanced design with narrow center guide and fully counterbalanced slide. The milling head is mounted on a vertical slide, water-cooled, and protected with pressure and thermal switches to insure proper cooling. Longitudinal, cross, and vertical milling feed rates from 0 to 50 inches per minute are provided, with traverse rate of 85 inches per minute.

The unit is available in sizes 30 by 24 inches, 36 by 24 inches, and 42 by 24 inches, with rated stroke lengths of 6, 8, 10, or 12 feet.

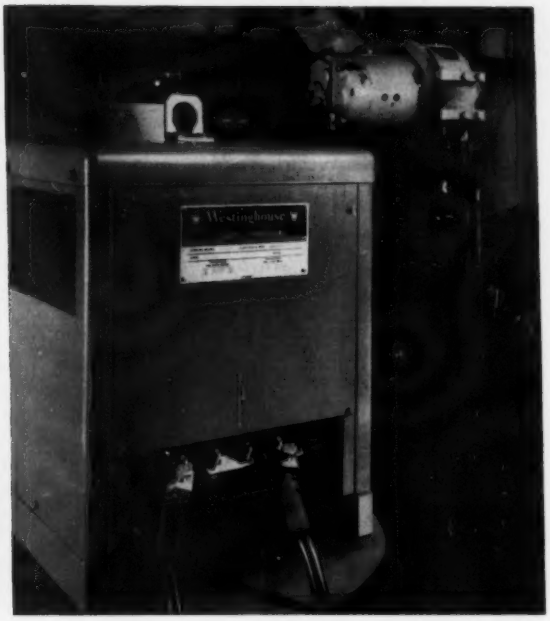
Circle Item 584 on postcard, page 171



Hydraulic swarfing machine for processing aircraft and guided-missile parts



Zagar two-station machine for processing a gun part



"Dynamic Reactor" for use in gas-shielded welding process

Two-Station Machine for Processing Gun Part

A standard drill head and feed components are incorporated in a machine built by Zagar Inc., Cleveland, Ohio, to process a gun part which might otherwise require the use of intricate machinery. The machine has two basic machining stations. There are six machining units, with three heads to each station—one horizontal, one vertical, and one inclined at a given angle.

At the first station the gun part is drilled simultaneously from the inclined, vertical, and rear horizontal units. The air-shuttle-operated table moves to the second station adjacent. One hole is tapped from the 15-degree inclined unit, four holes are tapped by the vertical head, and one hole is back counterbored from the rear horizontal unit. The cycle of operation is automatic after loading and unloading the machine. Hole sizes range from 0.116 to 0.404 inch. The holes are spaced as close as 0.250 inch center to center. The machining heads are fed by individual, mechanically controlled (by cams) drill units. Zagar gearless heads are used for the drilling, reaming, and tapping operations.

Circle Item 585 on postcard, page 171

Westinghouse "Dynamic Reactors" Developed to Broaden Range of Gas-Shielded Welding Process

Research by the Welding Department of the Westinghouse Electric Corporation, Pittsburgh, Pa., into the gas-shielded welding processes has led to a new type of power-supply equipment designed to bring the advantages of CO_2 welding to many new industrial applications. This equipment, designated "Dynamic Reactors," is suitable for use with any standard constant-potential, constant wire-speed system of metallic inert-gas welding. The "Dynamic Reactors" are compact, static, two-terminal packages that are connected in series with either of the welding current leads. Physically, the units are so designed that they can be placed near the welding machine or near the work.

By limiting the rate of rise of weld current, the reactors permit the use of lower weld currents and the transfer of weld metal in droplet form. In turn, lower currents and droplet transfer permit the use of larger and less expensive wire sizes, effective depth control of weld penetration and, for the first time, the use of the CO_2 process for vertical and overhead welding.

Pilot equipment already operating—principally in the automotive industry—is in use for automatic and semi-automatic welding of mild steel, but the process is equally applicable to stainless steel, aluminum, and non-ferrous alloys.

Dynamic reactors now in production at the Westinghouse welding department are of two sizes: The smaller—dual-rated at 150/300 amperes, 100 per cent duty cycle—is principally for nominal gage materials in semi-automatic setups and for semi- or full-automatic welding of thin gage materials. The larger unit—dual-rated at 300/600 amperes, 100 per cent duty cycle—is best suited for high-speed automatic or high-current semi-automatic types of welding applications.

Units rated at 150/300 amperes require 1 square foot of floor space, stand 19 inches high, and weigh 118 pounds. Units rated at 300/600 amperes are 18 inches wide, 13 inches deep, 26 inches high, and weigh approximately 220 pounds.

Circle Item 586 on postcard, page 171

Carl Zeiss Precision Measuring Equipment

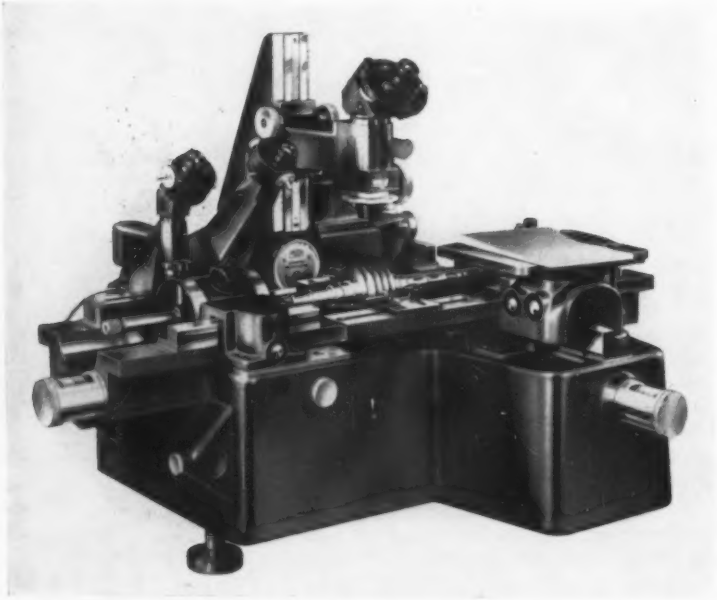
The George Scherr Co., Inc., New York City, has announced that it now has available the complete line of Carl Zeiss Jena optical measuring instruments which it handled prior to World War II. This line of high-precision, industrial measuring equipment includes such items as the "Universal Measuring Microscope" shown in the accompanying illustration. This equipment has a 4- by 8-inch range. It can be used for checking of cutting tools, control of gages, thread measurements, precision measurement of jigs and fixtures, as well as for checking extremely accurate work. It is especially adapted for the high-precision sectional and contour measurement of screw threads for general maximum-precision coordinate and angular measuring. Measurement is made by comparison with standard precision glass scales. The result is read through spiral micrometer microscopes to an accuracy of 0.000050 inch or 0.001 millimeter. This microscope can be had in metric and inch systems.

Of special interest is the length-measuring machine for external and internal measurements, which uses a graduated glass scale and an optical lever for direct readings to 0.000050 inch, having an outside measuring range of 40, 120, and 240 inches. Other instruments, namely, the vertical and the horizontal Metroscope, employ precision glass scales built into the measuring head or spindle, respectively, which are read through a spiral micrometer to 50 millionths of an inch.

The Optimeter uses auto-collimation as its basic principle, with an integral scale as the measuring means. The Zeiss optical dividing head has been designed for use on heavy milling, grinding, and drilling machines.

A fundamental instrument of measuring technique in the Zeiss line is the "Interference Comparator," which utilizes as its unit of length the unchanging wave length of light. All of these instruments, as well as gear-testing equipment, comparators, and other precision measuring tools, are now available.

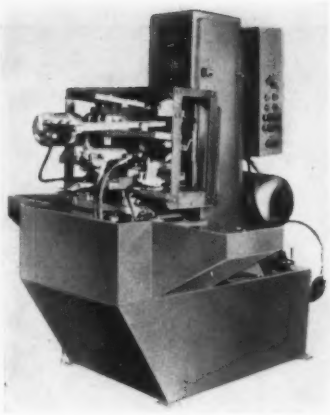
Circle Item 587 on postcard, page 171



Carl Zeiss Jena universal measuring microscope introduced in this country by the George Scherr Co., Inc.

Automatic Abrasive-Belt Rotor Grinder

A completely automatic, high-speed, precision rotor grinder has been announced by Engelberg, Inc., Syracuse, N.Y. This Model BG8/HT abrasive-belt machine grinds rotors to diameter tolerances of plus or minus 0.001 inch and to concentricity tolerances within 0.0005 inch. It handles rotors from 1 inch to 4 1/2 inches in diameter. Representative production rates, grinding to concentricity limits within 0.0005 inch and to plus or minus 0.001-inch diameter tolerances are given as follows: 180 per hour for rotors with outside diameters of 3 3/8 inches, with 2-inch stack, ground in pairs with 0.030-inch stock removal; 1440 per hour for rotors with outside diameters of 1 9/32 inches, with 7/8-inch stack (without shaft) ground in gangs of six work-pieces with 0.010-inch stock removal.



Engelberg automatic rotor grinder

The machine's rotor fixture consists of a regulating wheel and double or triple upper-feed and lower-discharge tracks. It is mounted on a heavy-duty electro-hydraulic feed table. Rotors are placed on the parallel sets of inclined feed tracks and roll down to the proper machine-loading position.

As the table of the machine infeeds, it is automatically oscillated (6-inch maximum stroke, with variable frequency of oscillation) to utilize the full width of the 9- by 107-inch abrasive belt. At the same time, rotors are dropped from each track, and the regulating wheel moves forward to hold them firmly in carbide-lined V-ways.

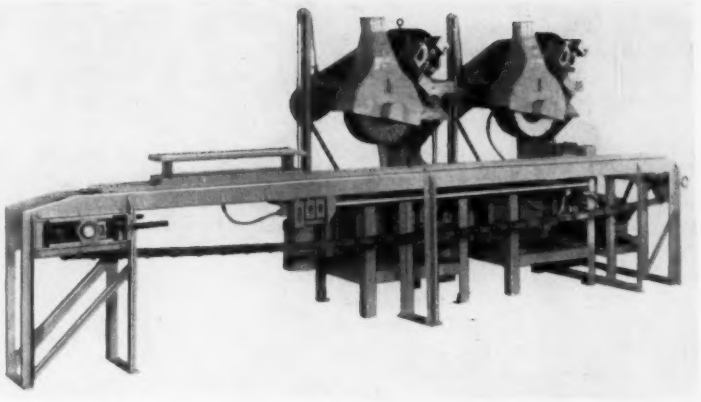
Circle Item 588 on postcard, page 171

Wilson Reciprocating Buffing Machine

A reciprocating buffing machine that can be fully automated has been announced by the Wilson Buffing Chuck & Machine Co., Warren, Mich. This equipment is available as a complete package, fully automated, and delivered wired for immediate use. It is designed for both low- and high-production runs.

For low-production runs, the conveyor may be run, forward and reverse, under the buffing heads using only one fixture. For high-production runs, the conveyor may be run as a continuous, over and under machine, by installation of the desired number of fixtures, on the conveyor chain. When run as a continuous buffer it will handle parts up to 4 feet in length. Extrusions and moldings, short or long—even in excess of 20 feet in length—may be buffed by merely providing a conveyor of the proper length.

The buffing heads are the full-floating type, balance weights being used to obtain proper pressure on the work. There is a swivel adjustment, at the base of each head, to permit cross buffing wherever desired. These buffing heads may be supplied with 5-, 7 1/2-, 10-, or 15-hp motors of the totally enclosed dustproof type.



Wilson reciprocating buffing machine with two full-floating buffing heads

Circle Item 589 on postcard, page 171

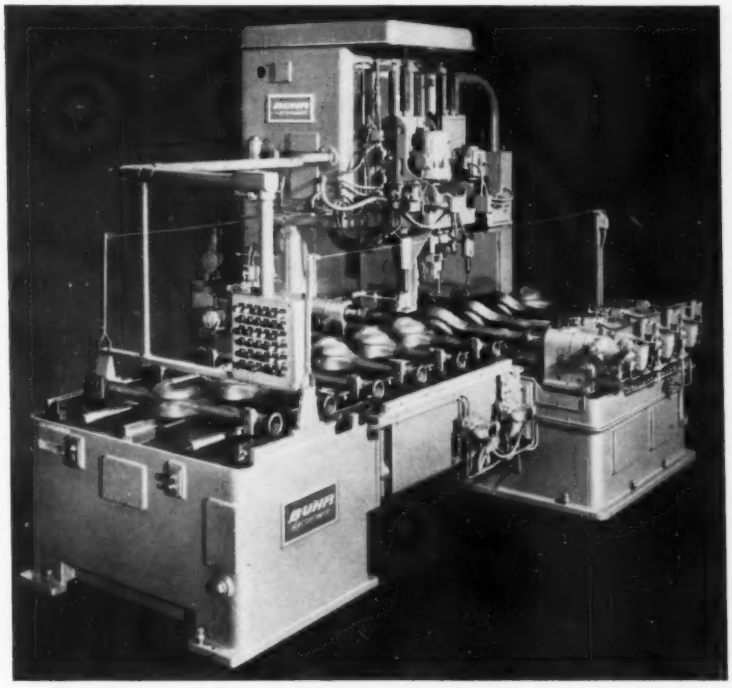
Buhr Versatile Transfer Machine

A versatile transfer machine built by the Buhr Machine Tool Co., Ann Arbor, Mich., has solved the problem of an automotive company that was spending large sums of money each year for new tooling to drill and finish a vent hole in rear-axle housings. Location of the hole, design of the housing, and equipment changed each year. Annual equipment cost has now been eliminated by the simple transfer machine illustrated. This automated machine, the cost of which was only as much as the retooling bill for one year, can be adjusted easily to drill the hole in any location dictated by present or future part designs.

By using a standard Buhr coolant base under the load station and by bridging the gap between this base and the main machine base with five idle stations, the transfer machine acts to flush out chips from previous operations and serves as the transferring device between the preceding operations (two trunnion machines) and the drilling operations.

In addition, a compound movement permits drilled holes to be deburred both top and bottom with the same tool bit, using the same hydraulic unit that feeds the drill in the adjacent station.

The operator on the trunnion machines unloads an in-process housing from one of the trunnions and deposits it in the loading station of the ten-station Buhr transfer machine. The part is placed on adjustable, notched rails that run the length of the transfer machine. These rails can take parts varying



Buhr Economatic transfer machine for processing rear-axle housings

as much as 8 inches in length—either 4 inches longer or shorter than the current model part.

Once a part is in the load station, the machine takes over, and coolant is immediately introduced under pressure from both ends. Chips are flushed toward the center and out because the normal position of the part is with the open face of the "banjo" section down. Parts have a chance to drip-dry during the trip through the five idle stations. All coolant flows back to the coolant base.

Work-pieces move in discrete steps through the five idle stations. At the seventh station the housing is rotated to the correct angle and a 7/16-inch hole is drilled at a cutting speed of 65 sfpm (surface feet per minute) with a feed of 4.5 inches per minute. In the eighth station both the inside and the outside of the hole are deburred. The hole is tapped in the ninth station. Housings are manually unloaded from the tenth station at a rate of about 180 pieces per hour at 80 per cent efficiency.

Circle Item 590 on postcard, page 171

Automatic-Cycle Machine for Spiral or Helical Milling

The Index Machine Co., Jackson, Mich., has just introduced a vertical milling machine designed to make it possible for small shops to be equipped for spiral or helical milling. Saving is said to be involved not only in the low original cost of the unit but also in operational cost, since the machine uses end-mills rather than the more expensive special milling cutters which are normally used for spiral-milling operations. The finish obtained is claimed to be superior to that resulting from conventional milling methods since a manually compensated nut on the lead-screw enables climb cutting to be employed in the spiral-milling operation.

The machine is automatic in operation and can be supplied equipped for one of two optional cycles. Other cycle arrangements are available on special order to meet specific customer requirements. The machine incorporates a dividing head geared to the table feed, and rapid-traverse return mechanism. The range of lead per revolution of work-piece is from 0.536 inch to 64.500 inches. Any lead normally obtainable with a dividing head is available. The required helix angle setting is obtained by tilting the head.

A major advantage of the automatic cycling arrangement is that it is unnecessary to disconnect or remove it when the machine is used for regular milling, drilling, or boring operations. However, it can be easily removed.

Circle Item 591 on postcard, page 171

Automatic Bench Type Drilling Machine

The Hartford Special Machinery Co., Hartford, Conn., has recently introduced a low-priced, automatic, precision drilling machine. This complete, bench type equipment is a typical example

Vertical spiral or helical automatic-cycle milling machine introduced by Index Machine Co.

Automatic, precision bench type drilling machine introduced by Hartford Special Machinery Co.

of the manufacturer's program of developing standard machine components, better known as "building blocks." The machine is equipped with an air-hydraulic drill unit having a total stroke of 1 1/2 inches which is adjustable for length of quick advance, feed rate, and depth of hole.

A wide range of spindle speeds is possible through the pulley drive. The unit is mounted on a sliding base with an end adjustment of 4 inches. The compact machine is only 12 inches wide by 21 inches long by 30 inches high. Included in the machine are pneumatic controls and electrical controls with a push-button station.

Circle Item 592 on postcard, page 171

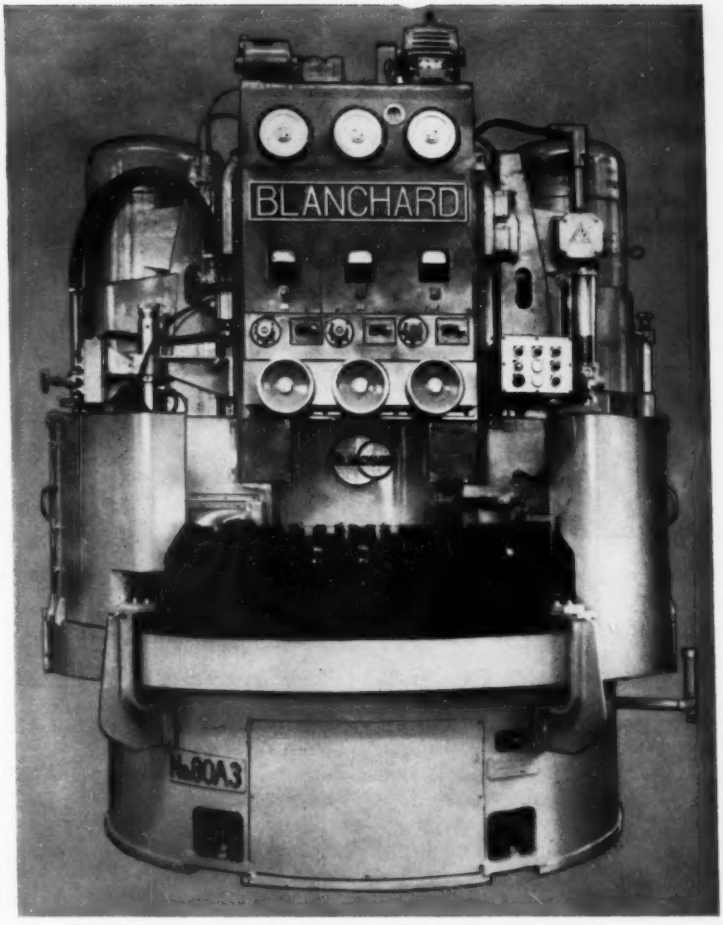
Dividing Head for Milling Machine Equipped to Use Lead-Screw Gears

A universal spiral-drive, telescopic type dividing head, which is adaptable for use on any milling machine, has been announced by the Greaves Machine Tool Co., Cincinnati, Ohio. A three-way adjustment made up of the two slots in the table bracket plus the double swivel built into the quadrant makes possible this wide versatility. Mounting of the dividing head in the field is possible on any make of milling machine.

The pendent-swivel quadrant allows the gears of the dividing head to swing into position where they can reach in and contact the gears on the lead-screw of any milling machine, regardless of the width of the table. The middle bracket, with its two slots, allows the dividing head to be mounted and used on the milling machine regardless of the width of coolant well at the end of the table. It also provides for leaving the quadrant and gears permanently mounted on the end of the table.

The universal dividing head can also be disengaged from the gear-train bracket or quadrant, and used as a plain dividing head. This is easily done, since the unit is telescopic, permitting the head to be withdrawn from the bracket. Right- or left-hand models, with or without the direct indexing feature, are available.

Circle Item 593 on postcard, page 171



Blanchard center-column automatic surface grinder

Center-Column Automatic Surface Grinder with Three Grinding-Wheel Spindles

The Blanchard Machine Co., Cambridge, Mass., is introducing a center-column automatic surface grinder having a work-table with an outside diameter of 80 inches which is equipped with three grinding-wheel spindles.

This grinder, designated the Blanchard 80-A3, is designed on the same operating principle as the automatic surface grinders previously introduced by the manufacturer. Each wheel is maintained at the correct height by a new "finger type" feed control caliper. Since the work-table is non-magnetic, all parts are held in fixtures during the complete grinding cycle.

The machine illustrated is employed to rough-grind both sides of the two ends of automotive connecting-rods. It will grind any work held within an area located between two concentric circles 48 and 80 inches in diameter. Cylindrical grinding wheels 18 inches in diameter and segment wheels 22 inches in diameter can be used on the spindles of this automatic machine.

Manual power is employed for the feed but motor power is used for rapid raising and lowering of the wheel-heads. A 25-, 30-, or 40-hp motor is used to drive each spindle. Table drive is by a 3-hp motor. The machine occupies a floor space 7 feet 8 inches by 8 feet 2 inches. It weighs approximately 40,000 pounds.

Circle Item 594 on postcard, page 171

Planer which cuts on both forward and reverse strokes brought out by the G. A. Gray Co.

Planer Designed to Cut on Forward and Return Strokes

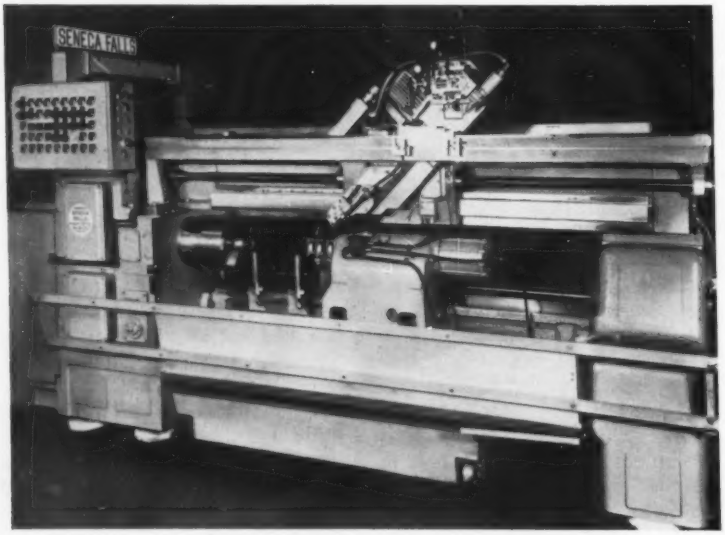
A universal planer that has no idle return stroke but cuts on both the forward and return strokes has been developed by the G. A. Gray Co., Cincinnati, Ohio. It is claimed that conventional, heavy-duty planing can be handled effortlessly on this machine due to its new square-lock design. Exceptional power, rigidity, and high speed make it well-adapted for efficient metal-cutting with carbide tools.

By activating a lever and a button the planer is instantly converted to double-cutting. The double-cutting technique can be combined with the regular single-cutting action to obtain triple-cutting. Rough- and semifinish planing are accomplished at the same time. Standard carbide tips are used in the simple double-cutting tools. This universal planer is now being manufactured in both the double-housing and open-side designs.

Circle Item 595 on postcard, page 171

Pre-Selector Dial System for Seneca Falls Lathes

Incorporation of a pre-selector machine-management system into its Model "Q" lathes is announced by the Seneca Falls Machine Co., Seneca Falls, N. Y. This system enables operators to "dial" setup changes and thus substantially reduce setup time. This feature makes the system particularly desirable on short-run operations. Both rough and finish passes are integrally controlled, permitting automatic sequencing from the rough to the finish passes without removing the work-piece from between centers.



Seneca Falls automatic lathe equipped with pre-selector dial system

Carriage travel and diameter of cuts for each pass with the tracer carriage are controlled by manually set dials mounted on the machine. A "start position," "end cut," and specific diameter are set for each pass. The machine will sequence automatically through as many as nine distinct roughing and semifinish passes before proceeding automatically to the finish cut. Only one template manufactured to the finished dimension of the work is required.

The tracing mechanism consists of a stylus, electric amplifier, mechanical power amplifier for positioning cross-slide, and a master

Fig. 1. Heald high-precision, low-cost universal grinder

template. Mechanical movement of stylus as it travels along creates an output voltage within the stylus housing. This voltage is amplified and controls speed and torque of low-power servo motor. The mechanical amplifier reproduces and magnifies the torque-speed variations and transmits exact stylus motion to the tracer slide.

For long-run operations, a multiple-tool type carriage may be installed on the rear bedways and surplus stock removed with a multiple tool setup. Longitudinal carriage movements are dial controlled and the cross-slide movement is cam controlled. The final finish pass is always made with the tracer carriage. Both Model LQ and AQ Seneca Falls lathes are available with "dial" and tracer systems.

Circle Item 596 on postcard, page 171

Heald Universal Grinder

A universal machine adapted for bore, outside diameter, and rotary surface grinding operations, which is capable of holding work within tolerances of 50 millionths of an inch for roundness, has been introduced by the Heald Machine Co., Worcester, Mass. The standard machine package is said to be priced at about half the cost of present models and less than a comparable machine with fewer features cost in 1947. It will be available as a basic machine with cross-slide as standard, plus "building-block" attachments.

This unit, Fig. 1, incorporates more features than any previous internal grinder, yet sells for less than half the price of presently available machines of the same type. A new development featured on this machine is the Hydrastatic anti-friction ways which support the table and cross-slide on "pockets" of oil without metal-to-metal contact. Horizontal and vertical control of the ways is maintained within 0.00030 inch. The 1800-pound table can be moved by a pressure of only 1/4 pound.

The standard machine has a table travel of 20 inches—greater than that of any previous Heald universal grinder. Work-head cross-slide travel is 11 1/2 inches. The work-head swivels 90 degrees. Infinitely variable speeds of 150 to 450 rpm are afforded through 1 1/2-hp variable speed work-head drive. The swing inside the standard guard is 12 inches for pieces 8 inches long.

Table speeds range from 0 to 15 fpm (feet per minute) for grinding and 35 fpm for rapid traverse. Roughing cross-feed is adjustable from 0.0001 to 0.0006 inch on the diameter.

Three wheel-head positions are possible, as shown in Fig. 2: (left) for normal bore grinding; (center) 2 inches forward for larger inside or outside diameter grinding; and (right) 7 1/2 inches forward for outside diameter or bore and face grinding with two wheel-heads. For surface grinding with a 6-inch wheel, users can grind the end of a 6 3/4-inch long work-piece with the wheel-head in standard position or the end of a 16 1/4-inch long work-piece with the wheel-head in the forward position. The standard dresser has coarse adjustment and is manually lifted. A duplicate dresser with coarse and fine adjustments and automatic lift is also available.

Circle Item 597 on postcard, page 171

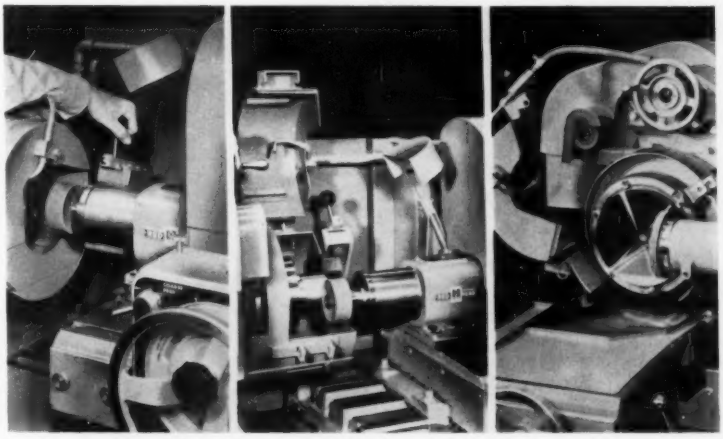


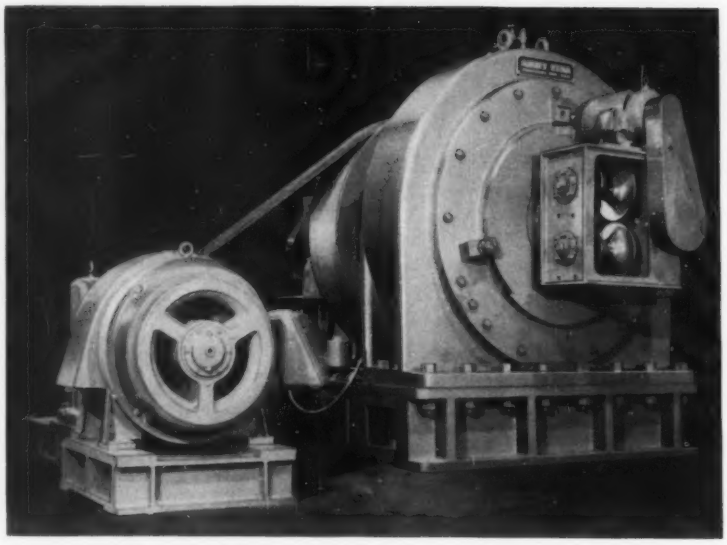
Fig. 2. Setups on grinder shown in Fig. 1 for internal, external, and surface-grinding operations

Giant-Size Swaging Machine

A huge swaging machine, believed to be the largest in the world, has just been built by the Abbey Etna Co., Perrysburg, Ohio. This equipment has been designed to accommodate tubes having an outside diameter of 8 inches.

Basically, swaging operations performed by conventional machines consist of reducing ductile metal bars, tubes, or blanks by shaping them through, or in, a rotating, closed die. When used for end reduction, tapering, etc., the piece being swaged must be inserted and withdrawn from the operator's end of the machine. An unusual feature of the Abbey Etna 900 series size swager is that the pipe lengths are passed completely through the swager spindle. The outside pipe diameter is reduced from 9 1/8 to 8 5/8 inches (8-inch standard pipe size) over a saran liner for the entire pipe length. Production of the 8-inch standard saran lined pipe is thus made possible by the 916 swager. The largest-size saran lined pipe previously available was 6 inches.

The 916 swager has power-driven rolls at both entrance and exit ends. It has a 16-inch die length; swages at the rate of approximately 15 feet per minute; delivers approximately 2000 hammer blows per minute at 88 rpm; and handles pipe with a minimum length of 10 feet. The maximum length of pipe that can be accommodated is limited only by pipe-handling facilities. Power is furnished by a 150-hp alternating-current motor with a V-belt drive. The machine is 8 feet high, covers a floor area of 16 by 12 feet, and weighs approximately 50 tons, including the drive. By changing dies and applying different feeding methods, the 916 swager can be made to accommodate 6-, 5-, 4-, 3-, and 2-inch pipe for all standard swaging operations such as end reduction, forging, etc.



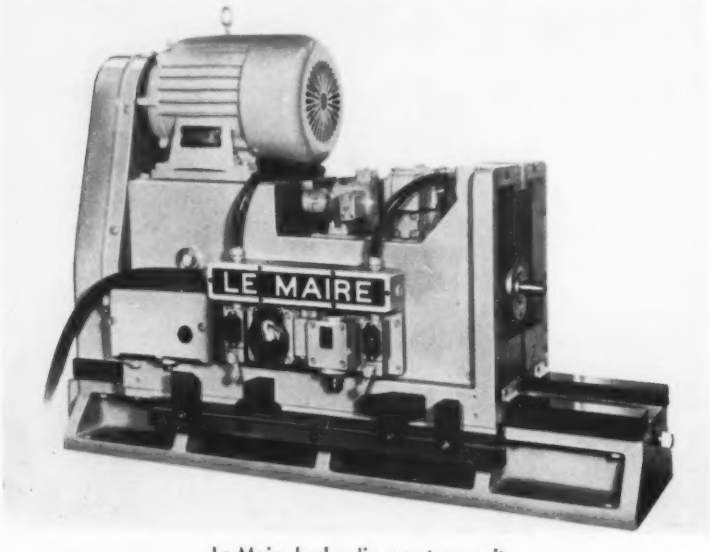
Huge pipe-swaging machine built by Abbey Etna Co.

Circle Item 598 on postcard, page 171

Way Type Unit for Drilling, Milling, and Similar Work

A versatile way type hydraulic unit that provides power for many machine tool operations has been introduced by the Le Maire Machine Tool Co., Dearborn, Mich. This unit of "building-block" construction is designed for simple, economical automation of machine tools. The SU-5 way type hydraulic unit illustrated can be used over and over on a wide variety of applications. Its design permits either horizontal or vertical mounting on machines for drilling, reaming, milling, boring, chamfering, and similar machining operations.

The units in this line are entirely self-contained, with cross-keyed construction that permits ready removal and remounting. Features include: variable-delivery pump, hardened and ground ways, automatic lubrication, and spindle-speed changes. For ease of maintenance and replacement, all component elements are manifolded and so arranged that they are readily accessible.



Le Maire hydraulic way type unit

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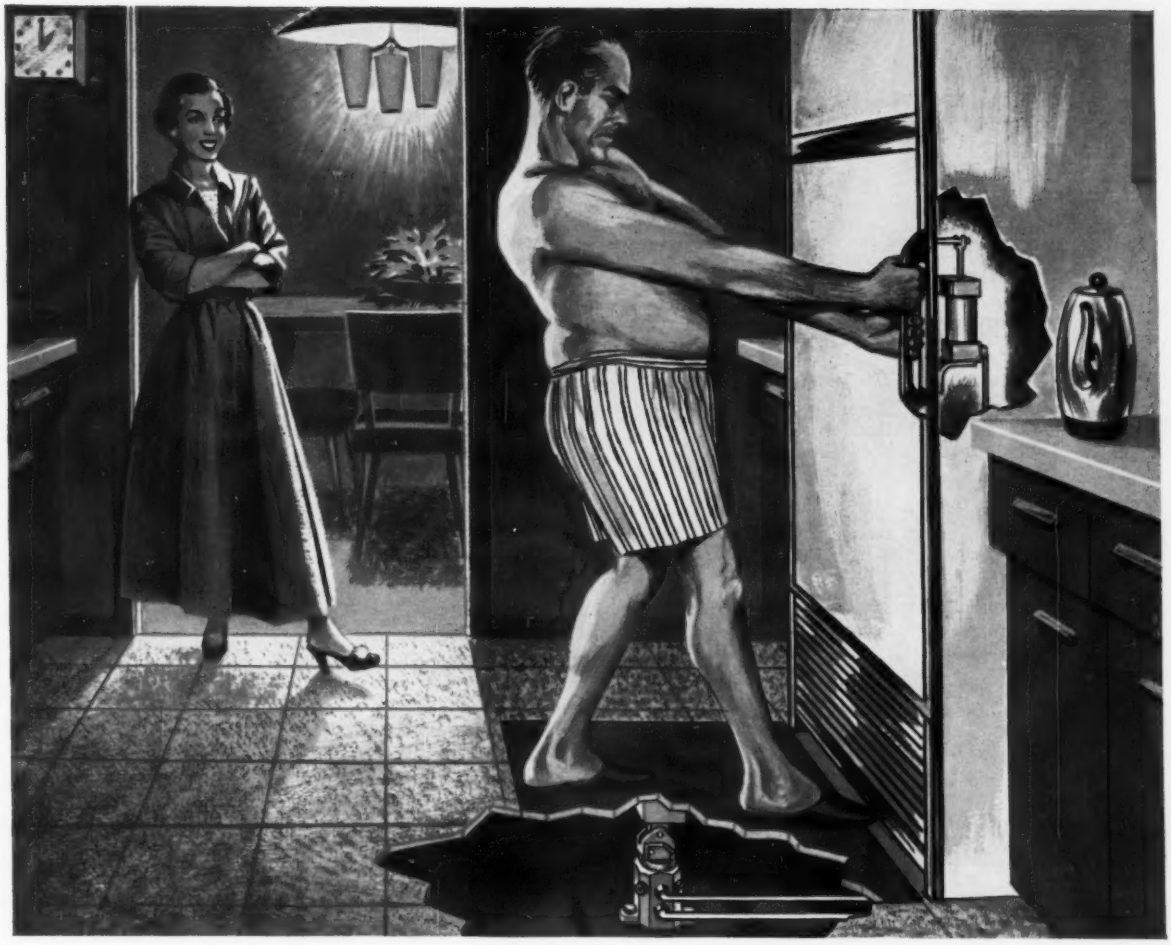


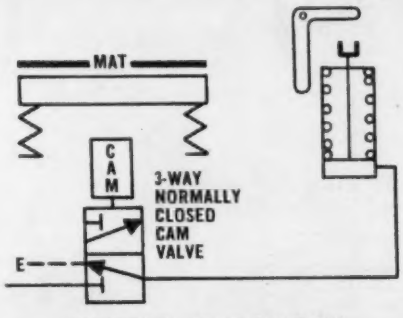
What? Air Won't Let Him Get Too Fat!

We admit we are not serious, but . . .

In a previous moment of strength he has set the controls—now, if he weighs over 200 pounds when he steps on the mat in front of the refrigerator, the door just won't open. But while he is under 200 pounds, no trouble. Now, it's highly unlikely that the refrigerator folks will be mobbed by eager buyers for such a diet-master model, but we have jumped on it as a good chance to show how a cam valve can say "yes" or "no."

Ross Cam Valves can "think" for your circuits, too

Cam valves are the key to air automation. They can act on almost any mechanical signal to set off . . . or restrict . . . another operation. Then still another cam valve can interlock that circuit with yet further operations and so on until any number of operations can be sequencing one another. Are you realizing the full possibilities from cam valves? The Ross line includes so many models, we invite you to call your Ross representative or write us.



SEQUENCE OF OPERATION

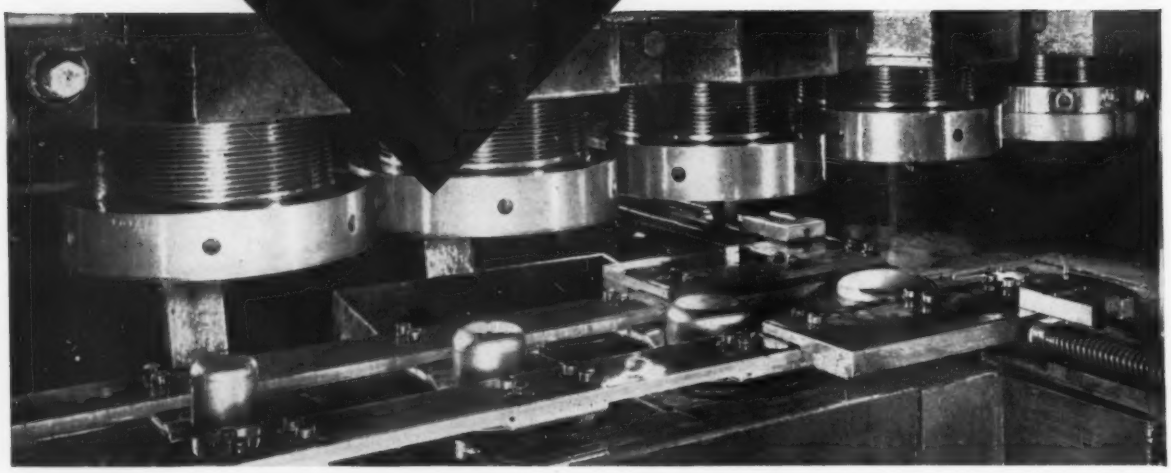
Sufficient weight on mat depresses cam, operating valve and moving cylinder to point where it restrains door handle from opening.

Ross OPERATING VALVE CO. 110 E. Golden Gate Ave. • Detroit 3, Michigan

For more data, circle this page number on inquiry card

MEL-TROL

at work



To deliver uniform performance between grinds, a drawing or blanking die has to be hard and tough through its whole thickness.

And no matter how well it is designed and heat treated, it can only be as uniform through the center as the bar you make it from . . . and the bar can only be as uniform as the ingot from which it is rolled.

That's why, when you make a die from Carpenter MEL-TROL air hardening die steels—such as No. 484 and No. 610 —you *know* you're going to get predictable performance. The high quality of MEL-TROL die steels is guarded by a system of the most advanced and accurate quality controls ever used in steel making.

And an exclusive Carpenter-patented mold produces ingots with greater uniformity through the center than any others made on a production basis today.

Why don't you try Carpenter MEL-TROL quality tool and die steels? Call your Carpenter representative and place your order today.

Carpenter STEEL

The Carpenter Steel Company, Main Office and Mills, Reading, Pa.
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NEW CATALOGUES

ROTARY BENDERS—Wallace Supplies Mfg. Co., Chicago, Ill. Booklet entitled "The Big W Brings You Rotary Bending Benefits," giving an over-all look at the company's line of rotary bending machines. It covers over sixty years of developments. Copies will be sent to readers upon request on company letterhead or to any members of an engineering or professional organization. Write to Wallace Supplies Mfg. Co., 1300 Diversey Parkway, Chicago 4, Ill.

BEARINGS AND MACHINE PARTS—Wakefield Bearing Corporation, Wakefield, Mass. Catalogue on Graphex, Coprex, and Woodex oilless and self-lubricating bearings, bushings, and machine parts, a useful reference guide for sintered metal parts. A free copy can be obtained by writing on company letterhead to the Wakefield Bearing Corporation, 29 Foundry St., Wakefield, Mass.

SAFETY BOOKLET—Grinding Wheel Institute, Cleveland, Ohio. Booklet entitled "Safety Recommendations for Grinding Wheel Operation," discussing in layman's language such technical subjects as maximum peripheral speeds, strength classification of grinding wheels, definitions of maximum speeds, the effect of wheel speed on grinding action, safety guards, mounted wheels, proper mounting procedures, truing and dressing, and the do's and don't's of safe grinding. **501**

RETAINING RINGS—Truarc Technical Service, Waldes Kohinoor, Inc., New York City. Catalogue No. RR 10-58, containing descriptions and illustrations of all currently available Waldes Truarc retaining rings, pliers, and accessory tools. It includes "Slector Guides" to the company's twenty standard ring series and thirty representative "special" rings designed for individual customer requirements, with detailed descriptions. . . **502**

ELECTRIC-FURNACE STEELS—Copperweld Steel Co., Aristoloy Steel Division, Warren, Ohio. Catalogue presenting complete information on electric-furnace steel production from the charging of the furnace with select scrap to finished blooms, billets, and bars ready for shipment. Also included is a complete listing of Aristoloy steels available in standard and special analyses, including those that can be furnished leaded. **503**

STEEL AND ALUMINUM DATA—Joseph T. Ryerson & Son, Inc., Chicago, Ill. 256-page, pocket-size Ryerson Data Book presenting aluminum analyses, characteristics, mechanical properties, and tolerances, in addition to previously published information on steel, such as machining and fabricating data, manufacturing practices and tolerances, weights, safe loads, ASTM standards, and compositions and properties. It also gives miscellaneous facts of value to purchasing agents and shop men. . . **504**

BEARING—Tycho Mfg. Co., La Grange, Ill. Brochure illustrating recirculating anti-friction way bearing. Designed to give unlimited travel, constant accuracy, and reduction of feed power, the Tychoway bearing is available in varied loads from 2000 pounds to 3200 pounds in standard precision and matched sets for extremely accurate application in precision machines. **505**

VALVES—Fluid Controls, Inc., Mentor, Ohio. Catalogue sheets containing revisions on differential, piston type relief valves manufactured by the company.

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5	27	49	71	93	169	191	213	235	257	705
6	28	50	72	94	170	192	214	236	258	706
7	29	51	73	95	171	193	215	237	259	707
8	30	52	74	96	172	194	216	238	260	708
9	31	53	75	97	173	195	217	239	261	709
10	32	54	76	98	174	196	218	240	262	710
11	33	55	77	99	175	197	219	241	263	711
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The valves, which are designed for pressure relief in critical hydraulic circuits where failure would be hazardous to personnel, are externally adjustable and capable of handling pressures from 100 to 5000 psi. **506**

SQUARING SHEARS—Wysong & Miles Co., Greensboro, N. C. Catalogue No. PS-222, describing Wysong's line of power squaring shears developed to meet requirements in shearing practically all types and thicknesses of sheet metals whose shear load does not exceed that of mild steel of 1/2-inch thickness. Extra equipment is covered. **507**

LIMIT SWITCHES—Micro Switch, a Division of Minneapolis-Honeywell Regulator Co., Freeport, Ill. Catalogue No. 84 covering a complete line of heavy-duty limit switches—the plug-in "200LS" series, featuring quick replaceability; the compact "LS" series; and the rugged "ML" switches, available in regular or explosion-proof types. **508**

POSITIONING TABLE—Industrial Controls Division, Topps Industries, Inc., Los Angeles, Calif. Brochure covering the company's larger size "Micro-Positioner" automatic positioning table. It is a tape-controlled, two-axis, point-to-point positioning table, with 16- by 24-inch working surface and 14- by 18-inch travel. **509**

GENERAL BULLETIN—Oilgear Co., Milwaukee, Wis. Bulletin 10051-G, including specifications, illustrations, and descriptive matter on the complete line of standard Oilgear and Servocontrol Division equipment. Included are: variable-delivery, one- and two-way pumps; constant-delivery, duplex, and automatic feed pumps; motors, etc. **510**

SPECIAL-PURPOSE ELECTRODES—Lincoln Electric Co., Cleveland, Ohio. Bulletin 7000.2, a procedure guide featuring Lincoln manual arc-welding electrodes for hard-surfacing and for welding stainless steels, non-ferrous metals, and cast iron. The Weldirectory describes each electrode and its properties and applications. **511**

TUBULAR PRODUCTS—Tubular Products Division, Babcock & Wilcox Co., Beaver Falls, Pa. Folder TDC-190, containing technical data on analyses, corrosion and oxidation resistance, high- and low-temperature characteristics, and physical and mechanical properties of the family of 18-8 stainless steels. .**512**

ALLOY FABRICATION—Haynes Stellite Co., Division of Union Carbide Corporation, New York City. Booklet telling how to fabricate "Hastelloy" alloys. It covers step-by-step procedures and recommendations for welding, forging, forming, machining, grinding, brazing, heat-treating, and descaling and pickling. **513**

CUTTING MACHINE — Allison-Campbell Division, American Chain & Cable Co., Bridgeport, Conn. Bulletin DH-84, describing Model 481 wet abrasive cut-off machine, the modern answer to tough cutoff jobs of heavy industry. Work-holding fixtures, machine design characteristics, and complete specifications are listed. **514**

ENGINEERING AND APPLICATION—Cleveland Tramrail Division, Cleveland Crane & Engineering Co., Wickliffe, Ohio. Booklet No. 2008-N, giving detailed studies of track design, peening, and stresses. Also covered are various types of carriers, cranes, tractors, track switches, buckets, grabs, and electrification. **515**

MICROHARDNESS TESTERS — Newage Industries, Inc., Jenkintown, Pa. Bulletin describing low-cost microhardness tester that permits direct, accurate readings, corresponding to Vickers, within 15 seconds by measuring resistance hydrostatically. It eliminates a microscope, conversion charts, and complicated tables. **516**

HYPOID TESTER—Gleason Works, Rochester, N. Y. Circular featuring the No. 17A hypoid tester, designed for testing the running qualities of straight-, spiral-, Zerol® bevel, and hypoid gears whose shafts intersect at 90 degrees. It can be arranged for speeds up to 4000 rpm. **517**

COLLET SYSTEM—Chi-Co, Inc., Northfield, Ohio. Bulletin featuring "Super-Flex" collet system which is adaptable to all machines and available in four graduated series; total capacity range from 1/8 inch to 2 1/2 inches in 1/32-inch increments. Accessories are included. **518**

BENDING MACHINES—Pedrick Tool & Machine Co., Inc., Philadelphia, Pa. Bulletin No. 58, picturing and describing the firm's complete line of compression process, production bending machines and accessories, but also giving much useful information on general bending theory and practice. **519**

GEARS—Illinois Gear & Machine Co., Chicago, Ill. Bulletin 26 IG, describing the company's products (custom gears), plant facilities, quality-control facilities, as well as information on capacities, types, processes, materials, heat-treatments, equipment, etc. **520**

FLEXIBLE SHAFTS—Stow Mfg. Co., Binghamton, N. Y. Catalogue No. 59, presenting attachments for grinding, sanding, polishing, buffing, wire brushing, sanding wood, and drilling in steel or wood. These machines are available with truck, pedestal, bench, and suspension type mountings. **521**

BORING MACHINES—Ex-Cell-O Corporation, Detroit, Mich. Brochure presenting precision boring machines that are

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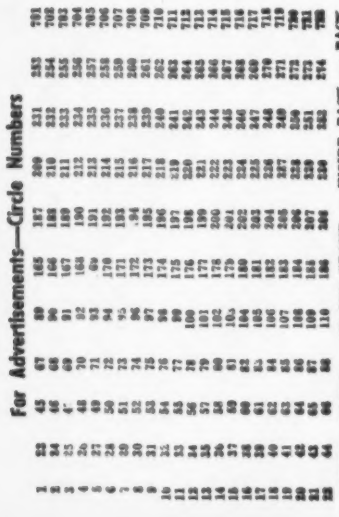

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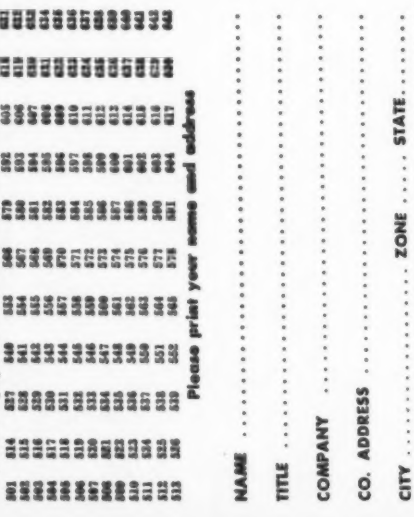

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heavy-duty, hydraulically operated models accommodating large work-pieces and heavy fixtures. Style 771 is a single-end machine; the 772 is for double-end operations. 522

ASSEMBLY TOOLS—Truarc Technical Service, Waldes Kohinoor, Inc., New York City. Catalogue No. AT 10-58, containing complete engineering dimensions and specifications for all Waldes Truarc retaining-ring pliers, applicators, dispensers, and grooving tools. 523

INSTRUMENT BEARINGS—Split Ball-bearing Division of MPB, Inc., Lebanon, N. H. Catalogue No. 59, describing a line of thin-section ball bearings, made in precision and ultra-precision grades to dimensions of the AFBMA B-500 "T" series. 524

VISES AND WORK-HOLDING FIXTURES—Universal Vise & Tool Co., Parma, Mich. Catalogue No. 9158CJ, describing a full line of machine vises, rotary tables, adjustable angle plates, standard setup fixtures, and the new Universal Clamp-N-Jack Setup System for all types of machine tools. 525

AUTOMATIC CONTROL — Micro-Path Inc., A Division of Topp Industries, Inc. Inglewood, Calif. Booklet presenting details of a system for automatic control of machine tools using magnetic-tape programming without the need for computer techniques and equipment. 526

CUTTERS—W. F. Meyers Co., Inc., Bedford, Ind. Catalogue describing carbide cutting tools. Many special cutters are available for slotting, slitting, cutting, or forming cast iron, plastics, hard rubber, celluloid, bone, ivory, copper, aluminum, and paper tubing. 527

NOTCHING UNITS—Wales-Strippit, Inc., Akron, N. Y. Catalogue N, showing a wide variety of notching operations which can be readily set up in stamping presses and press brakes in unlimited patterns—for short job runs or long production runs. 528

MARKING MACHINES—Acromark Co., Elizabeth, N. J. Catalogue No. 9, describing and giving general specifications of the latest model of automatic, semi-automatic, and hand-operated rotary marking machines, designated Acromark Model No. 9. 529

ABRASIVE WHEEL—Simonds Abrasive Co., Philadelphia, Pa. Catalogue, (Form ESA-244), introducing the Double XX depressed-center abrasive wheel for weld grinding and general offhand use on portable disc type sanders and right-angle grinders. 530

PRECISION BORING MACHINE—Olofsson Corporation, Lansing, Mich. Bulletin presenting a heavy-duty, high-production machine, the Olofsson Model 22, engineered for both precision and heavier machining operations. 531

PRESSES—Niagara Machine & Tool Works, Buffalo, N. Y. Bulletin No. 64, introducing the redesigned and expanded line of Niagara's straight-side, single- and double-crank presses which extend from 50- through 500-ton capacities. 532

STAMPING PRESSES—Alpha Press & Machine, Inc., Detroit, Mich. Bulletin No. 855P, describing the Alpha line of high-speed, two-point, underdrive stamping presses. Standard capacities range from 50 to 300 tons. 533

PRECISION EQUIPMENT — Challenge Machinery Co., Grand Haven, Mich. Catalogue No. 839, covering over 300 standard items of the company's precision surface equipment. Included are both semi-steel and granite surface plates. 534

MOUNTED WHEELS—Chicago Wheel & Mfg. Co., Chicago, Ill. Bulletin No. 1505, presenting mounted wheels in 200 standard sizes and 86 shapes available in a variety of bonds, including vitrified, resinoid, and soft rubber polishing. .535

MILLING AND BORING—Cutter Division, Ingersoll Milling Machine Co., Rockford, Ill. Booklet B-68, entitled "Winning Combinations That Reduce the Cost of Chips." It contains facts on milling and boring operations. 536

TURRET LATHES—Gisholt Machine Co., Madison, Wis. Fastermatic automatic chucking turret lathe catalogue (Form 1179-A), explaining basic machine principles whereby speeds, feeds, and machine functions can be pre-selected electrically, cutting setup time 50 per cent. 537

CHAIN CONVEYORS—Acme Chain Corporation, Holyoke, Mass. Catalogue featuring a complete line of roller chains, sprockets, and attachments, plus valuable engineering formulas and installations. 538

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SWAGE NUTS—Standard Pressed Steel Co., Jenkintown, Pa. Bulletin 2447, featuring a self-swaging, clinch type nut for putting load-bearing threads into thin metal fast and economically. **539**

COIL-HANDLING EQUIPMENT—F. J. Littell Machine Co., Chicago, Ill. Catalogue (Section S), presenting a line of automatic roll feeds, reels and cradles, etc., for use in coil handling, straightening, and feeding. **540**

PRESSES—Williams-White & Co., Moline, Ill. Catalogue (Form 78), presenting a line of hydraulic gap-frame straightening presses. Specifications and description of controls are included. **541**

INTERCHANGEABLE CYLINDER—Tomkins-Johnson Co., Jackson, Mich. Bulletin #SQ 10-58, describing and relating complete technical data concerning the new T-J "Squair Heat" interchangeable cylinder. **542**

AIR CONTROL—Perfecting Service Co., Charlotte, N. C. Bulletin No. 80, describing a completely new air-line filter that uses an interchangeable "throw-away" type filter cartridge. **543**

POWER PRESS BRAKE—Niagara Machine & Tool Works, Buffalo, N. Y. Bulletin 90 Supplement, introducing the 15-ton power press brake, latest addition to the company's line of seventy-six standard models ranging up to 900 tons. **544**

TOOL-HOLDERS—Viking Tool Co., Shelton, Conn. Catalogue describing a new line of throw-away insert tool-holders that eliminate the necessity for a separate chip-breaker. **545**

LEAD CHECKER—Michigan Tool Co., Detroit, Mich. Bulletin featuring gear checker, Model 1218A—with an integrated optical system for easy and accurate checking of gear leads. **546**

SHEAR—W. A. Whitney Mfg. Co., Rockford, Ill. Brochure announcing hydraulic angle-iron shears, only 26 inches high with 18-ton capacity, designated Model No. 607. .....**547**

TOOTH-SPACING CHECKER—Gleason Works, Rochester, N. Y. Catalogue No. 115, discussing features, operation, and advantages of the No. 115 automatic tooth-spacing and concentricity checker. **548**

PNEUMATIC TOOLS—Thomas C. Wilson, Inc., New York City. Bulletin PT-58, describing a line of portable grinders, wire brushing machines, horizontal buffers, etc. **549**

THREAD COMPARATORS — Pratt & Whitney Co., Inc., West Hartford, Conn. Booklet No. 606 10-58, presenting TRI-ROLL dial type comparator gages. **550**

FILTERS—American Optical Co., Southbridge, Mass. Circular featuring an R-90 variable-density filter for the AO R-2090 and R-5090 respirators. **551**

STATIONARY AIR HOUSING—Conway Clutch Co., Cincinnati, Ohio. Bulletin No. 858, describing the features of stationary-housing air clutches. **552**

FURNACES—Sunbeam Equipment Corporation, Meadville, Pa. Folder listing benefits of company's line of industrial furnaces for any application. **553**

PRESSES—Federal Press Co., Elkhart, Ind. Catalogue featuring the firm's line of newly designed open-back, inclinable presses. **554**

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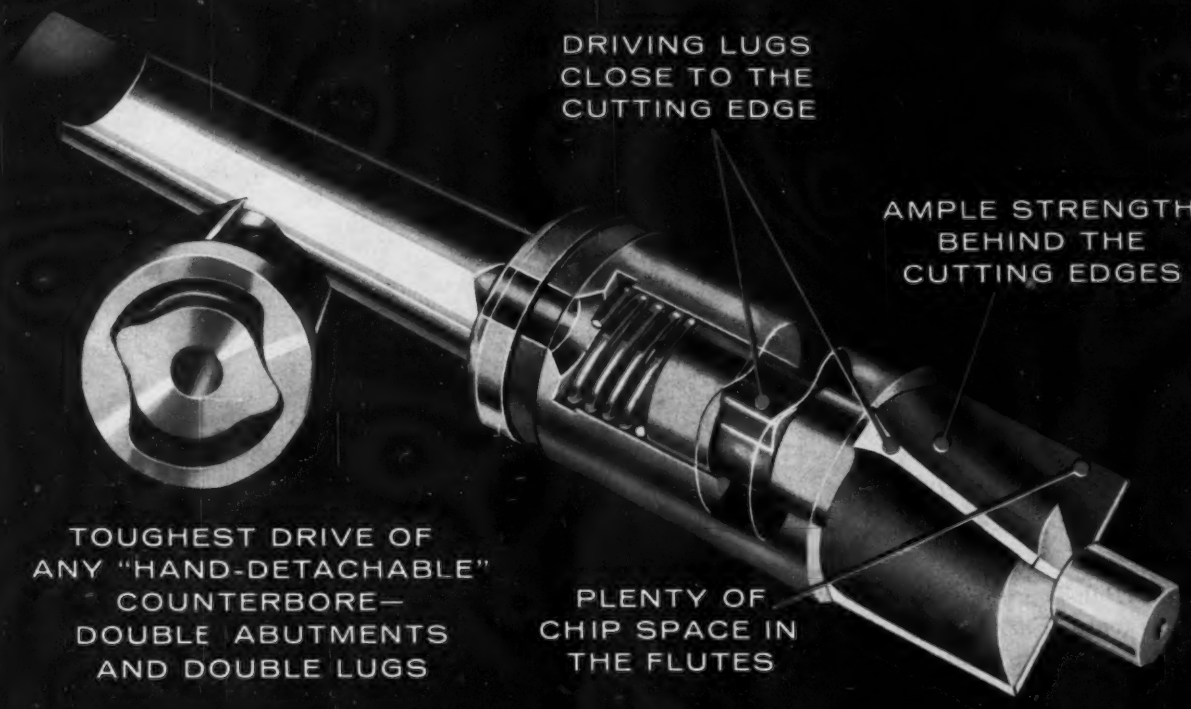


Here's why Continental Counterbores last longer

58-48

A quarter-turn by hand engages or releases a Continental Counterbore. This Standard Drive is also used for Continental spotfacers, countersinks, inverted cutters and special end-cutting tools.

Quality material and care in manufacture are two good reasons why Continental Counterbores last longer. Another reason is design.

Because of the way double driving lugs on the cutter shank engage abutments in the holder socket, driving forces simply create *compression*, not shearing or wedging action. The result is a balanced, positive drive—the toughest drive of any "hand-detachable" counterbore.

Notice how close the drive lugs are to the seating shoulder of the cutter. They're designed that way to give the extra torsional rigidity needed to resist machining forces. Flute design provides ample area for smooth chip flow, easy cutting.

And, of course, no matter how heavy the cut, a Continental Counterbore will always disengage with just a *twist of the wrist.*

Write direct, or ask your Ex-Cell-O Representative for a free copy of a new booklet that lists standard Counterbore sizes and tells everything you'll want to know about these versatile tools.

Continental CTW TOOL WORKS

DIVISION OF EX-CELL-O CORPORATION, DETROIT 32, MICHIGAN

For more data, circle this page number on inquiry card 175

Refix Pipe-Bending Machines

Wharton Unitools, Valley Stream, N. Y., is introducing in this country a line of four Refix pipe-bending machines. Model A is a low-priced hydraulic machine with a pressure of 15 tons and a pipe capacity of 3/8 inch to 2 inches. A somewhat larger unit having the same capacity is known as Model C. Model S also has the same capacity but incorporates a reverse pressure system. Model HD is similar to Model S, but has a larger capacity—3/8 inch to 3 inches.

Circle Item 600 on postcard, page 171

Model A Refix pipe-bending machine introduced by Wharton Unitools

High-Temperature High-Vacuum Furnace with Metal-Shield Insulation

High vacuums, temperatures up to 2700 degrees F., and fast response in heat-treatment and brazing cycles can be obtained in a new electric, bell type furnace developed by the General Electric Co., Schenectady, N. Y. Cylindrical metal shields instead of brick insulate the inside walls of this furnace. Quick heat-up and cooling cycles are characteristic of the new furnace, which is used principally for heat-treating alloys of stainless steel and refractory metals such as titanium and zirconium. Since there is no insulating brick, a high vacuum can be quickly obtained and easily maintained.

The furnace casing is water jacketed to keep it cool, thus retaining strength to withstand atmospheric pressure while the work load is at very high temperatures. Losses due to convection are reduced by the vacuum in the furnace. Protective gas atmosphere can also be used in the furnace.

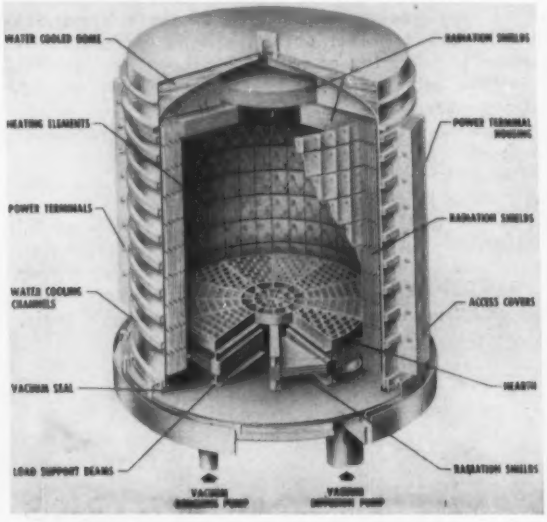
The radiation shields of heat-resisting alloy metal are arranged in several layers of concentric cylindrical shells on the inside walls of the heating chamber. The top and bottom have separated layers of alloy sheets in a horizontal position. The metal forms a complete enclosure around the material being heat-treated, retarding heat losses from the furnace due to radiation.

Circle Item 601 on postcard, page 171

Tape Search Feature for Bendix Numerical-Control Systems

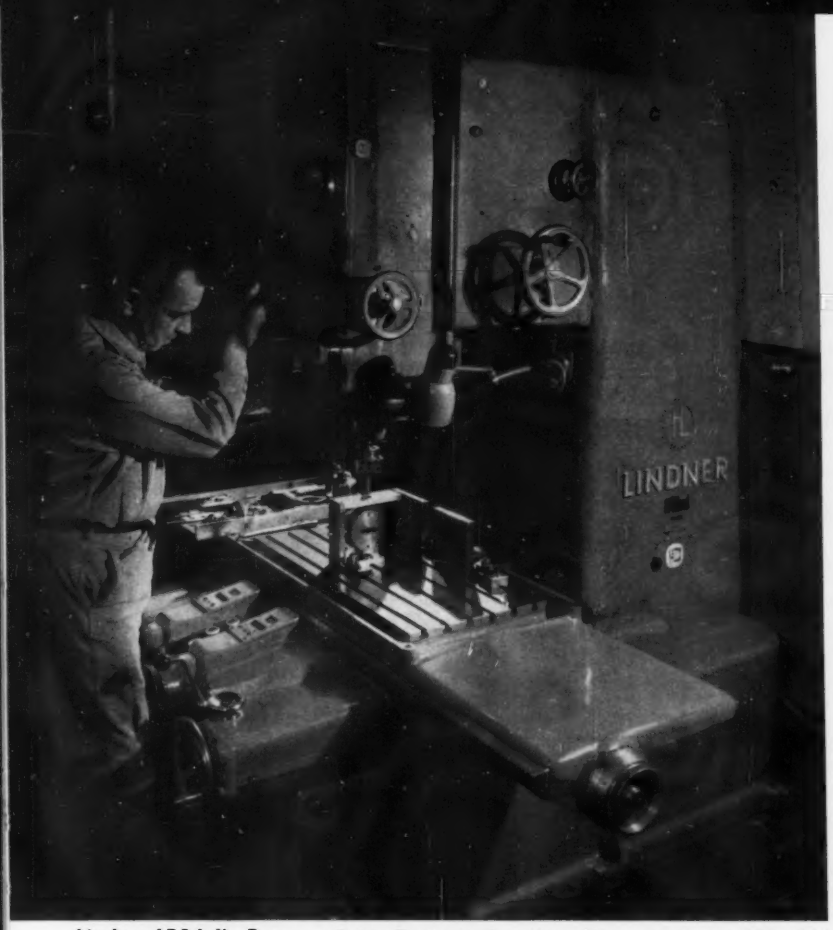
A tape search feature for automatic selection of up to 100 specific parts or part reference points, and for auxiliary on-off control functions, is now available on an improved machine tool numerical control system built by the Industrial Controls Section, Bendix Aviation Corporation, Detroit, Mich. This feature permits the inclusion of control for many parts on one reel of tape and eliminates the necessity of changing tapes for each different part to be machined.

With this system, each part is given a number. The operator, by setting two rotary switches, selects the number of the part to be machined. The machine control tape is then automatically repositioned to the beginning of the selected program. When the tape has been repositioned, an optional two-digit decimal display indicates the program or part to be automatically machined by the numerically con-



General Electric furnace insulated with metal shields

Tape search equipment mounted on Bendix control unit



Lindner LB14 Jig Borer at Philips Electronics, Inc., Mount Vernon, N. Y., has 32" x 16" table. Also available in larger model, LB15A with Autopositioner®—Table 44" x 24".

Precision Production—Boring 20 holes in the specimen plate cover of the Norelco Model 100KV Spectrograph. Done in one set-up. Time: 2 hours. 30% *faster than previous methods!*

Precision Tooling—Boring holes in a drill jig for the Norelco Powder Camera. Opposite holes must be aligned within .0001".

How the Lindner Optical Measuring System brings greater precision to jig boring

at Philips Electronics, Inc.

A jig borer can be no more accurate than its measuring system. And in the Lindner the problem of maintaining *permanent* accuracy has been solved by the machine's unique *fully optical* measuring system.

No lead screws. No gage blocks. No bars or limit switches. The helically scribed, cylindrical measuring scales in every Lindner are touched by a light beam only. These scales are independent of the table movement mechanism and *immovable* in axial direction. Thus, the whole system is permanently protected against any mechanical wear whatsoever. Lifetime accuracy!

Visual fatigue and errors in settings are minimized by a photo-electric centering device. It makes possible initial and repeat settings guaranteed accurate within .00015" over the full length of travel and readings in .00005".

There's no eye strain or bending. A helical line from the measuring scale is projected onto a 2½" wide screen which the operator reads from a standing position. No eyepiece required.

That's why Philips Electronics—like so many other precision producers—relies on the Lindner for tooling, production and inspection of its Norelco atom measuring equipment and other precision research tools.

The Lindner optical measuring system is changing ideas about jig boring all over the country. We've packed all the facts into a meaty 25-minute movie film. Send for it today without obligation. Or write for literature.

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trolled machine tool. In the event of an emergency stop such as power failure, tool breakage, etc., during the machining of a specific part, the reference search feature easily and quickly assists the machine operator to regain synchronization between the machine tool and the machine control tape.

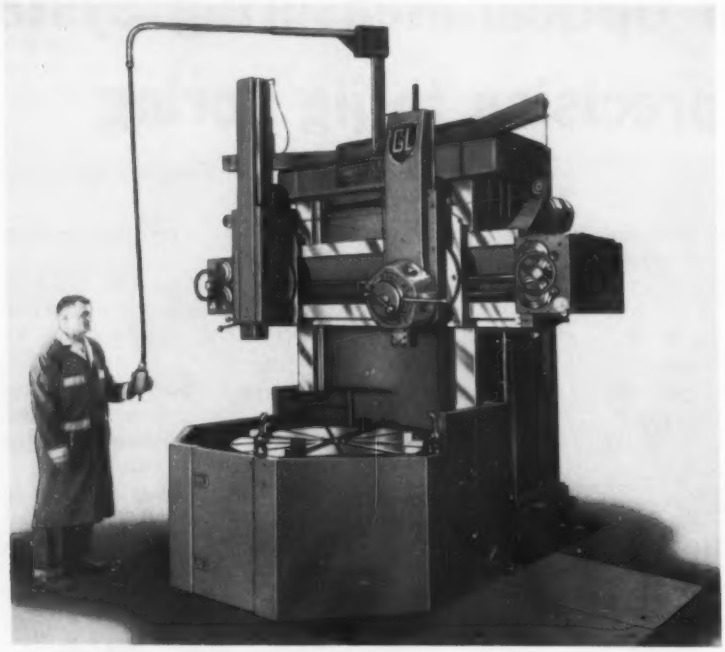
In another application of this feature, up to 100 reference codes can be punched on the machine control tape at points corresponding to various key part positions in a long machining operation. The operator's work sheet gives the coordinates for these positions.

The electronic construction of the machine control unit also permits the tape reader of this unit to read and control up to 80 on-off auxiliary-control functions which are punched in a special code on the machine control tape. These features make it feasible to do high-production, "single chucking" manufacturing of low production parts. The auxiliary controls automatically regulate such functions as coolant flow, chip conveyance, spindle power, and speed selection. They also return tape to starting position, control clamping, table indexing, tool changes, and other on-off functions that might be required on a numerically controlled machine tool.

Circle Item 602 on postcard, page 171

Giddings & Lewis All-Electric Vertical Turret Lathe

A 52-inch, all-electric vertical turret lathe announced by the Kaukauna Division, Giddings & Lewis Machine Tool Co., Kaukauna, Wis., is said to be more compact than conventional machines of the same rated capacity and to require one-third less floor space. The design of this machine permits the use of rigid, close-coupled tooling such as is needed for high-speed machining with carbide and ceramic tools. All 32 speeds in the two ranges available on this machine are obtained from a coaxial, planetary transmission, which fits into a small space in the housing. Thus all four planetary gear sets have a common axis. Gear combinations are "linked" through the control circuit by energizing different series of electric clutches, permitting the gears to be in constant mesh.



Vertical all-electric turret lathe announced by the Kaukauna Division, Giddings & Lewis Machine Tool Co.

The benefits of electric-power transmission control include: provision for changing speeds while the table is in motion and the tool is cutting; wider range of speeds available from a more compact drive; and simplified control whether using a push-button or automatic tape system. For example, directional joy sticks control horizontal and vertical movement of rail-heads and side-head, with tools moving in the direction the operator points the stick. Moving this stick at a 45-degree angle engages both horizontal and vertical drives for a 45-degree feed. Depressing a button on the end of the stick provides the same motion in rapid traverse. Dual directional levers are provided for raising and lowering the rail. All table functions are controlled from the pendent, including actuation of the power chuck and selection of speeds by a direct-reading dial.

Concentric, circular micro dials on the feed-boxes permit reading head movement in both directions to 0.001 inch. The micro dials are graduated for full linear tool positioning. They facilitate positioning adjustments necessary when setting up the machine for automatic operation by tape control.

Other features include counterbalanced rail-heads, non-metallic saddle bearings, constant-pressure lubrication system, high-capacity table bearings, and single, hammer-action handwheels for positioning ram and saddle. Machines are available with a wide range of optional equipment, including constant cutting speed, thread cutting, tracer control, and a new discrete-positioning tape-control system. The tape-control system provides complete flexibility for setup and permits making tool-wear compensating adjustments through the control console without altering the master tape.

The standard machine is equipped with a 50-hp motor. It has thirty-two table speeds in a low range from 5 to 67 rpm and high range from 20 to 272 rpm. Twenty-two independent feed rates are provided for each head, ranging from 0.0007 to 0.576 inch per revolution.

Circle Item 603 on postcard, page 171

(*This section continued on page 180*)

How a leading automotive manufacturer Snyder-izes for the Soaring Sixties

HOLDS PISTON WEIGHTS ± 2 GRAMS AT 600 PER HOUR

This Snyder transfer machine automatically weighs die cast aluminum pistons and mills them to tolerances of ± 2 grams at double the rate of the previous method. Here's how it turns out 600 parts per hour:

Pistons are transferred bottoms-up to orienting station.

Pistons are oriented in relation to the wristpin hole offset.

Pistons are spun right side up (below at right) while they are advanced to weighing station.

Precise overweight is transmitted by memory system to weigh-mill station during transfer.

A 3¼" milling cutter removes excess with the piston clamped in position.

Gaging station re-weighs pistons to check weight. Deviation from part tolerances stops machine.

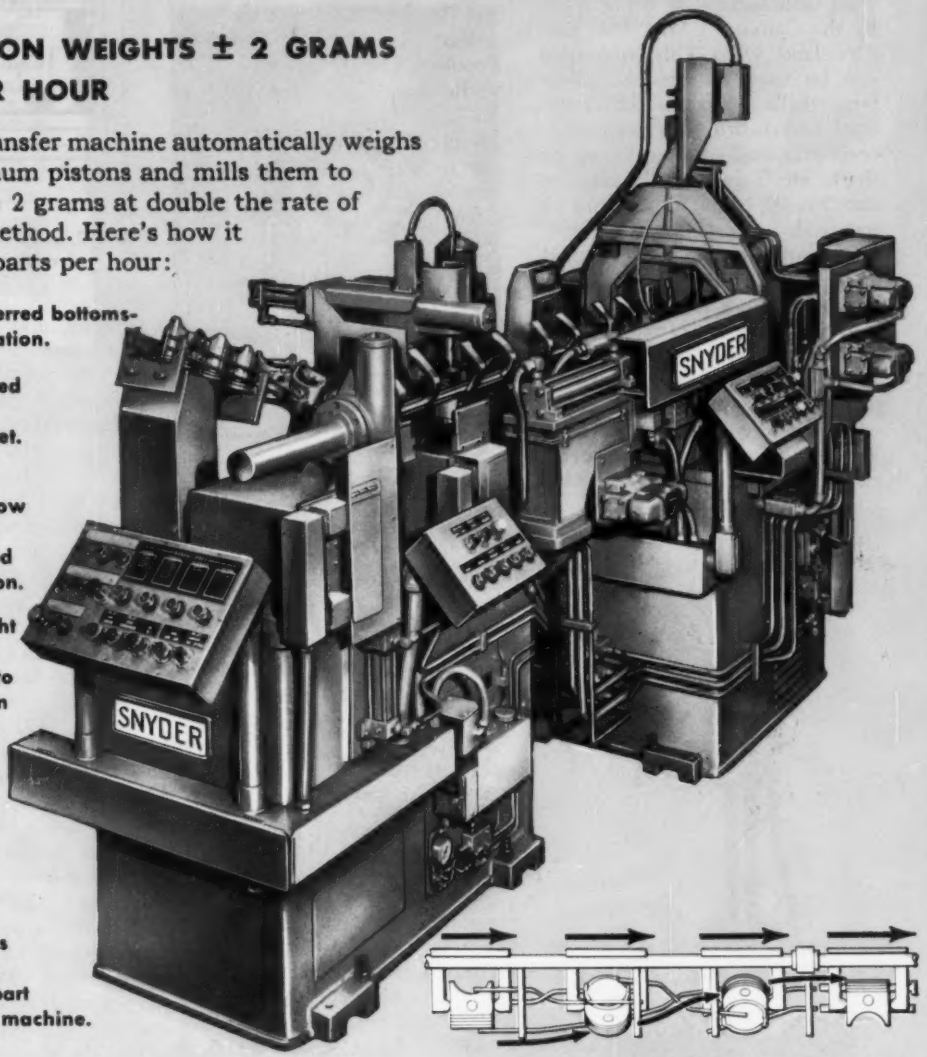


Diagram shows end over end rotation of piston as it passes through spiral rails.

Do your manufacturing cost problems revolve around parts handling, gaging and assembly as well as machining? Ask us to show you the benefits of SNYDER-IZING FOR THE SOARING SIXTIES. For a resume of SNYDER special machines engineered for profit opportunities, send for our new brochure or phone.

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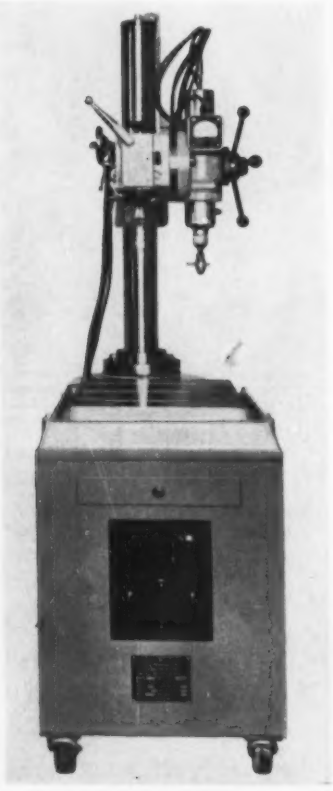
Cammann Metal Disintegrator

A Model C-86 metal disintegrator designed to arc-drill holes of any shape in hardened steels, titanium, borium, stainless steel, Stellite, Hastelloy, honeycomb steel, and Inconel is being made by the Cammann Mfg. Co., Inc., Cleveland, Ohio. This equipment can be used to remove broken taps, drills, reamers, set-screws, hardened bearings, races, hardened pins, and case hardening on shafts, etc. Taps from the smallest size, No. 00, to the largest, can be removed.

Work-pieces are not damaged or threads distorted by the disintegrator. Tools and dies are worked in the heat-treated stage without annealing. The hardness of the work is not affected. Compound-angle cuts can be made without pilot bushings. Three 360-degree setups give universal all-angle operation for a wide range of difficult jobs.



Metal disintegrator made by Cammann Mfg. Co., Inc.

The distintegrator can be quickly set up. It is of extra-heavy mechanical and electrical construction, easy to move, and works on or off the table. The net weight is 1250 lbs.

Circle Item 604 on postcard, page 171

Fig. 1. Operator loading parts to be finished on Abrado-Matic fixture

Mechanical Abrasive-Media Finishing Machine

The Abrado Finish Corporation, Grand Rapids, Mich., has announced a new type of mechanical finishing machine called the Abrado-Matic TS-31. This unit, Fig. 1, is said to introduce a new technique for vertical, mechanical injection of parts to be finished in a rotating mass of abrasive media. It is claimed that this process reduces the finishing time on many parts to as low as 10 seconds. The machine can be used on all types of metals and alloys requiring rapid, low-cost surface processing, with extremely uniform results.

The basic function of the unit is to finish the external surfaces of all types of precision-machined parts requiring uniform deburring, radius forming, removal or blending of machining or grinding marks, or improvement of the micro-inch finish. Because part dimensions can be held to extremely close tolerances, this equipment is especially well-suited for use in automotive, appliance, and similar industries. Refrigerator compressor pump shafts, bearing-retainer rings, and automatic-transmission components, as well as aircraft, jet

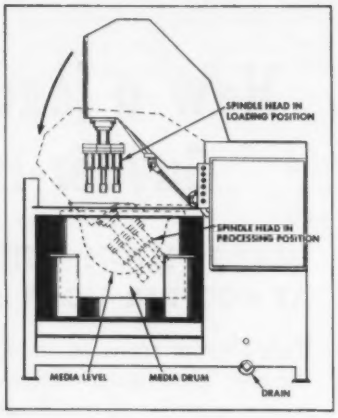


Fig. 2. Diagram illustrating operation of machine shown in Fig. 1

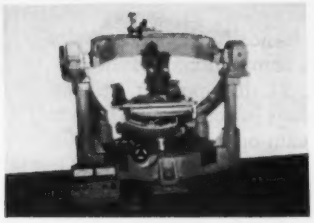
engine, and guided-missile parts have been successfully finished.

The operation starts with the placing of unfinished parts in the Abrado-Matic fixture attached to the centrally located spindle directly in front of the operator, who then presses the starter control button which activates an air cylinder attached to the fixture-holding spindle. The part is lowered into the rotating abrasive mass to the position indicated by dotted lines in Fig. 2. At the same time the fixture is being lowered into the flowing media, it is rotated slowly at a suitable speed, predetermined by experimentation, for the parts to be finished. Thus, all exposed surfaces of the parts being finished are subjected to the flowing abrasive action resulting from the rotation of the media in the tub.

At the end of the predetermined time cycle, whether 5 seconds, 30 seconds, or even as long as 5 minutes, the spindle automatically raises. The parts are removed from the abrasive media and returned to the loading position. As the spindle travels upward and out of the tub, the finished parts are sprayed with a cleaning solution which removes the loose abrasive particles and residue from the abrading action of the finishing media. The operator then pushes a foot pedal, causing the air clamp in the fixture to release the finished parts, which are removed and replaced by unfinished ones.

Circle Item 605 on postcard, page 171

(This section continued on page 182)



Modern celestial navigation systems for sophisticated jet bombers use the Simulacrum astro-tracker test table pictured above. The Alignment Fixture for this intricate instrument establishes a point to simulate a star . . . and the alignment calibration must be accurate to one second of arc, for an error as small as one second could result in serious inaccuracies. Consequently, the machining of the Alignment Fixture must be accomplished with extreme precision, as pictured in the finish milling of the critical bearing surfaces at the B. G. Instrument Corporation of Corona, New York.

B.G. INSTRUMENT CORP

Xydroptic-6A

SIP

Production with precision

When the job consists of a variety of operations on so critical a part as the Alignment Fixture for the Simulacrum, it is all but mandatory to machine it on the SIP HYDROPTIC. For work of this character, the ultimate in precision is maintained . . . axial centers must be absolutely "dead accurate" (within a tenth) . . . and all bores and locating surfaces must be within an accumulated error not exceeding 0.0005".

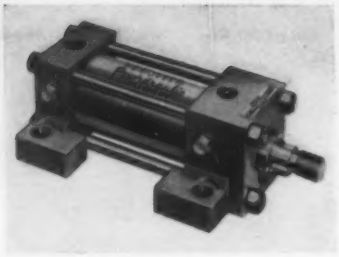
Here you see the machining of this Fixture in progress—on the SIP HYDROPTIC 6A Jig Boring and Milling Machine . . . in the temperature-controlled jig boring room of the B. G. Instrument Corporation of Corona, New York.

In the new series of HYDROPTICS . . . featuring greater ease of operation, increased range and capacity, and a guaranteed visual accuracy of 0.00015" . . . the basic Precision that is SIP assures confidence whenever critically accurate machining is demanded. Catalog No. 1149 tells the complete story of the SIP HYDROPTIC 6A, send for it.

AMERICAN SIP CORPORATION

HIGH PRECISION MACHINE TOOLS & MEASURING EQUIPMENT

100 EAST 42nd STREET, NEW YORK 17, N. Y.



Powrdraulic hydraulic cylinder

Hanna Powrdraulic Hydraulic Cylinder

A line of Powrdraulic hydraulic cylinders introduced by the Hanna Engineering Works, Chicago, Ill., features a pressure-tightening tube seal. This O-ring seal is located on the outside diameter of the tube and is fully confined between the tube and cylinder head. Because the seal is on the outside diameter of the tube, minute expansion of the tube under pressure squeezes the O-ring, increasing the tightness of the seal.

These cylinders are rated at 2000 to 3000 psi non-shock service and have a generous safety margin. Bore sizes range from 1 1/2 through 8 inches. Thirteen basic models and a choice of rod sizes permit the selection of a standard cylinder for practically every application. The Powrdraulic cylinders have industry standard mounting dimensions and conform to JIC recommendations.

The cylinders have double-seal piston rings and a quick-change cartridge gland with an automatically lubricated bearing. The cast-iron piston rings are bidirectional seals and are said to have the sealing power of six conventional piston rings. An optional piston with "U" packings of synthetic rubber and a gland with multiple-lip seals are also available.

Circle Item 606 on postcard, page 171

Heavy-Duty Drill Pointer

A heavy-duty drill pointer has been added to the No. 21 line made by the Oliver Instrument Co., Adrian, Mich. This heavier-duty model is designed to permit extension of the drill size range for the unique Oliver point previously obtained only on the Oliver No. 510 drill pointer, which has a maximum diameter capacity of three inches. This drill grinding technique provides a more intensive clearance angle on the point as the drill web is approached.

While basically the same as its standard companion, the heavy-duty No. 21 drill pointer utilizes ball bearings in conjunction with a special, cam-operated stud. This controls horizontal motion as the drill moves across the grinding wheel face to produce the desired point. The capacity of the new machine is identical with the standard model which is 3/32 to 1/2 inch. Included as standard equipment are: 1/4-hp motor, grinding wheel, diamond dresser, jaw assemblies, and setting gage.

Circle Item 607 on postcard, page 171

Precision Grinding Machines

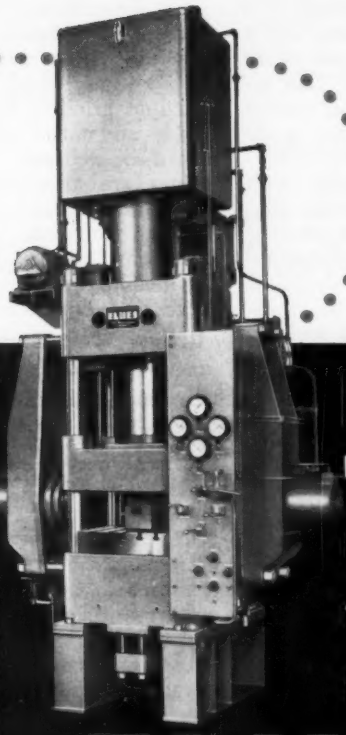
A vertical, single-spindle precision grinding machine is the latest addition to the line of grinding equipment introduced by the Frauenthal Division, Kaydon Engineering Corporation, Muskegon, Mich. This Series 1200 machine is a fixed-rail design and is available in two sizes and two models.

The 1224 size has a table 24 inches in diameter and a maximum swing capacity of 36 inches. The 1236/42 size has a table 42 inches in diameter and a maximum swing capacity of 48 inches. The compound slide swivels 45 de-

Drill pointer brought out by Oliver Instrument Co.

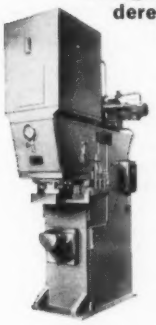
Frauenthal single-spindle vertical precision grinder

Because of what this unique DEVELOPMENT PRESS tells us...

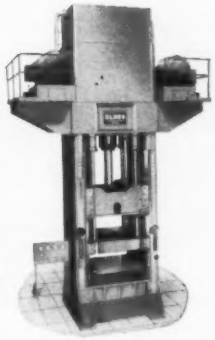


no pressing problem is too tough for an ELMES "Job-Fitted" HYDRAULIC PRESS

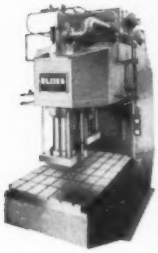
Elmes Presses are built in standard and special designs for metal drawing and forming, bending, straightening, forcing, powdered metal compacting, hobbing, etc.



HORNING PRESSES — for coining and truing wheel rims and similar items. Built in a wide range of sizes and capacities.



DOUBLE-ACTION DRAWING AND FORMING PRESS with 300-ton main slide and 100-ton blankholder slide. (Total tonnage is available for single action.) Single and Triple-Action types also available.



SPECIAL 600-TON C-FRAME PRESS — an adaptation of a standard C-Frame design. Combines two 300-ton presses in one. The unit can be operated with both cylinders in unison, or as individual presses.

The ingenious try-out press shown above is an exclusive creation of Elmes engineering. Center of activity in the Elmes Research Department, this versatile unit, with *four rams*, can be set up on *almost any operation that a hydraulic press is normally called upon to perform.*

Thus, a customer's out-of-the-ordinary metal pressing work can be tried out, and specifications for a production press of maximum efficiency accurately determined—not just on paper, but after having been *performance-proved under actual working conditions.*

Research with this press also permits the engineering of greater unusual-job adaptability into standard Elmes® Presses. As a result, where a standard Elmes Press does not fully meet a customer's requirements, it can be readily, efficiently, and economically modified in design.

Send us *your* pressing problem—you'll find that Elmes facilities can save time and money on your development work. See your Elmes Distributor, or write direct.

Elmes American Steel Foundries ENGINEERING DIVISION

1162 Tennessee Avenue, Cincinnati 29, Ohio

METAL-WORKING PRESSES • PLASTICS MOLDING PRESSES • PUMPS • ACCUMULATORS

For more data, circle this page number on inquiry card 183

grees either side of center. The grinding spindle, in turn, has a swivel range of 90 degrees either side of the slide center. This arrangement permits a wide variety of spindle-slide positions to be employed.

Each size is available with either a belt-driven grinding spindle or a direct-connected grinding spindle to suit a particular application. The belt-driven model is especially suitable for bore grinding operations on parts such as gears, die sections, valve plugs and seats, motor frames, and similar applications. The direct-connected model is especially adapted for multiple grinding operations on inside- and outside-diameter work and associated surfaces. The machines are arranged to permit feed, traverse, and reciprocation in both horizontal and vertical directions. All operating controls are mounted in a conveniently located push-button control panel.

Circle Item 608 on postcard, page 171

Moore Precision Jig-Boring Machine

The Moore Special Tool Co., Inc., Bridgeport, Conn., is introducing a Model No. 3 precision jig-borer. This machine has a greater range and larger table than its No. 1 and No. 2 predecessors. The table of the new unit is 11 by 24 inches by 20 13/16 inches high. The locating, boring, drilling, and reaming of holes in dies, jigs, and production parts can be accomplished on the No. 3 jig-borer with an accuracy much finer than the 0.0001-inch limits previously accepted as satisfactory for most precision jig-boring operations.

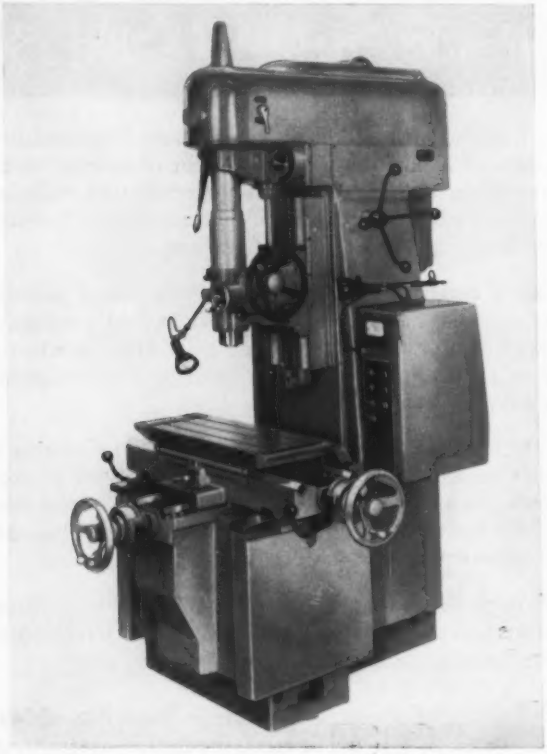
The tolerances for accuracy of positioning are as follows: greatest error in any inch of longitudinal travel is 30 millionths of an inch and in 18 inches of travel, 90 millionths of an inch; for cross travel the greatest error in any inch of travel is 30 millionths of an inch, and in 11 inches of travel, 90 millionths of an inch; and the tolerances for squareness are 60 millionths of an inch for the compound slide (full travel), 90 millionths of an inch in 12 inches of travel for the spindle housing travel, and 90 millionths of an inch in 5 inches of spindle travel.

Circle Item 609 on postcard, page 171

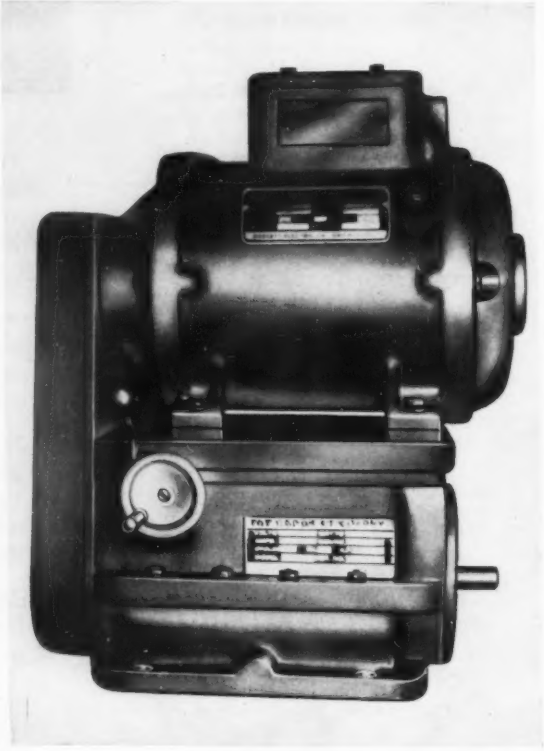
Hydraulic Variable-Speed Drive

A 1 1/2-hp electric motor, driving a variable-displacement hydraulic pump through silent chain and sprocket, which in turn drives a fixed displacement hydraulic motor, constitutes a new variable speed drive introduced by the Roberts Mfg. Co., Chicago, Ill. Rotation of a handwheel provides an infinitely variable speed control from 0 to 750 rpm.

A reversing lever provides instantaneous reversal of the direction of rotation. Reversing is independent of speed control. The hydraulic unit is completely self-contained in a sealed aluminum



Precision jig-boring machine brought out by the Moore Special Tool Co.



Variable-speed reversible hydraulic drive introduced by the Roberts Mfg. Co.

This valve gets a leak-proof seal from a Blanchard Surface Grinder

"The Blanchard Surface Grinder is one of the most important improvements in our modernization program." This report comes from the Commercial Refrigeration Division of Bendix-Westinghouse Automotive Air Brake Company—makers of power and condensing units for refrigeration equipment.

The Blanchard No. 18 Surface Grinder puts a surface of 5 micro inches or better on Bendix-Westinghouse valves at the rate of 75 pieces an hour.

A Blanchard Model 18 Surface Grinder is used to finish grind valve plates used in Bendix-Westinghouse electric refrigeration compressors. They say: "This operation is very important, because—with a surface finish of five micro inches or better—we get a perfect seal on our gaskets and valves, eliminating the possibility of leakage."

Is there room for improvement in *your* surface grinding? For best results...

Write today for your free copy of "Work done on the Blanchard," fifth edition, and "The Art of Blanchard Surface Grinding," fourth edition.

PUT IT ON THE BLANCHARD

THE BLANCHARD MACHINE COMPANY

64 STATE ST., CAMBRIDGE 39, MASS., U. S. A.

reservoir which holds two quarts of oil. The output shaft is 5/8 inch in diameter and has a standard keyway.

A 1 1/2-hp ball-bearing motor is available in either 3-phase, 60-cycle, 220-volt; or single-phase, 60-cycle, 220-volt capacitor type. The unit is 12 inches long, 7 1/2 inches wide, 16 1/2 inches high, and weighs 90 lbs.

This unit is adapted for use on lathe heads, reamer drives, conveyors, printing presses, cream separators, garden tractors, midget cars, pumps, blowers, canning machines, milling machines, test benches, and many other types of machinery or equipment.

Circle Item 610 on postcard, page 171

Flexible Mask Goggle

An improved 482A flexible goggle is announced by American Optical Co., Southbridge, Mass. This goggle features a larger and deeper mask than previous models, resulting in a greater area of protection and a better facial fit. It easily fits over all types of personal and safety glasses. The mask is made of soft, flexible vinylite and easily conforms to facial contours. Lens is easily removed and replaced. Elastic headband quickly adjusts and holds to proper head size. This goggle is recommended for protection against flying particles striking from any direction in babbitting, chipping, cutting rivets, light grinding, and on hand or light machine tool operations. The goggle comes with clear frame—clear or green lens.

Goggle with flexible mask made by American Optical Co.

Circle Item 611 on postcard, page 171

Ames Precision Air Gage and Checking Device

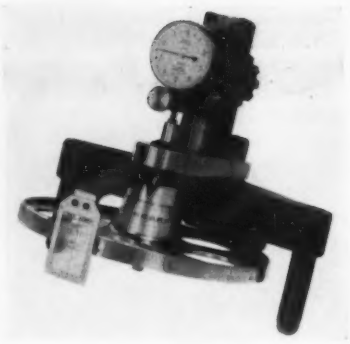
An easy-to-use air gage that permits accurate measurement to one-millionth of an inch (0.000001 inch) has been developed by the B. C. Ames Co., Waltham, Mass.

Precision air gage developed by the B. C. Ames Co.

This gage, designated Model AG, can be used to check inside diameters or dimensions, outside diameters or dimensions, and center distances of holes, regardless of hole size. It can also be used for checking the roundness of outside or inside diameter work and blind holes on small precision parts.

The dial of the meter has large graduations for fast, easy reading. If a permanent record of measurements is required, an electric recording unit may be added to the gage. The unit will register, on special sensitized paper, a permanent record of all readings made by the gage.

Zero setting can be obtained by using either a master or proper size blocks. Once the setting is made, a three-point contact enables the user to detect a 3-, 5-, or 7-lobe condition in centerless ground work.



Ames dial-indicator checking device

The Ames dial-indicator checking device described in December MACHINERY, page 206, was shown incorrectly on its side instead of as here illustrated.

Circle Item 612 on postcard, page 171

Stationaire Clutches

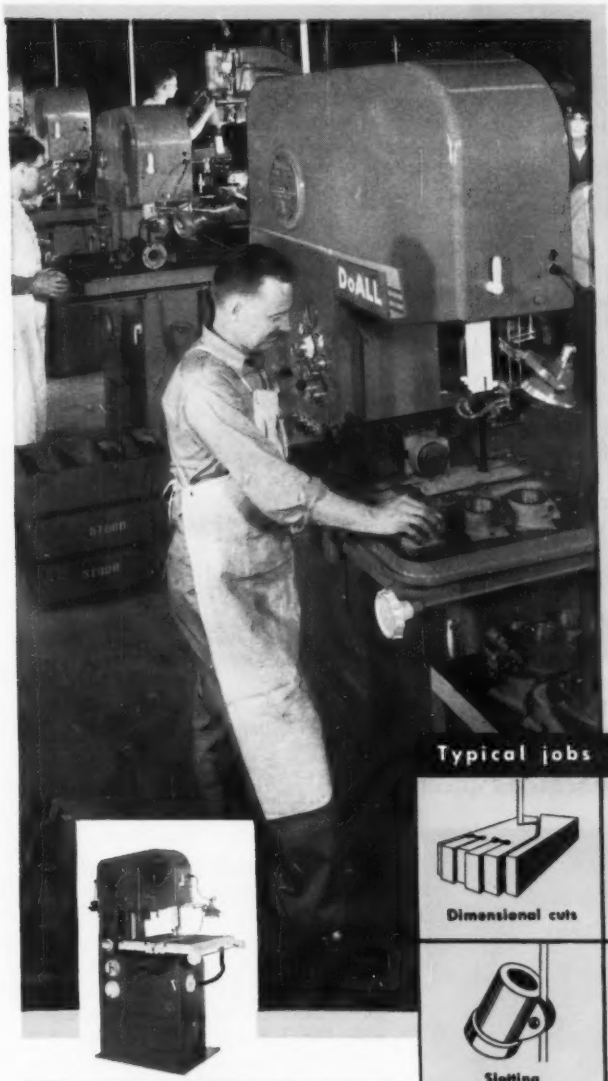
The Conway Clutch Co., Cincinnati, Ohio, is introducing a line of air-operated clutches in sizes and styles to meet a wide range of applications. This "Stationaire" line offers for the first time the stationary air housing feature which greatly simplifies installation. It is only necessary to slide the clutch on the shaft, no drilling or machining operations being required. The clutch can be put anywhere on the shaft, even in the center of a long one, or can be used to couple shafts together.

Circle Item 613 on postcard, page 171

Stationaire clutch of new line introduced by Conway Clutch Co.

(*This section continued on page 188*)

DoALL *UPSETS* old machining methods with the NEW *Contour-matic*® Band Machines



New ways to cut costs

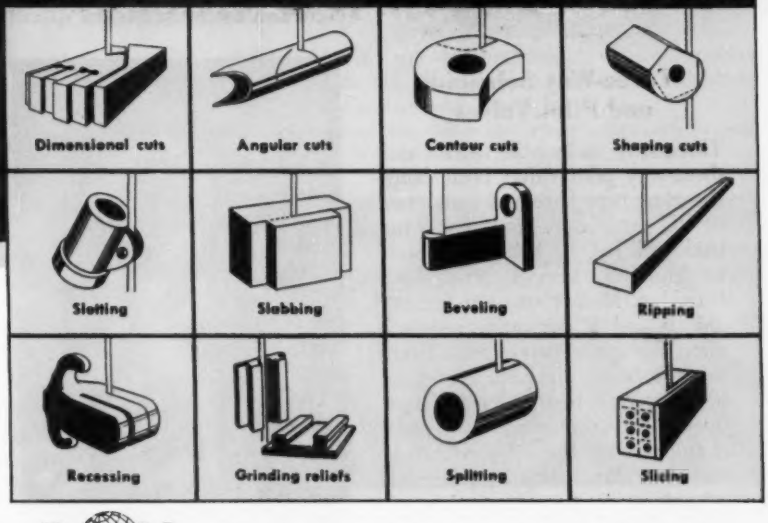
This is the time—*right now*—for production men and methods engineers to take a good, long look at some of the "accepted" machining practices . . . to break away from old habits in the light of new developments and performance in band machining.

Think of it! The new Contour-matics give you an average of 650% faster cutting rate . . . 30 times longer tool life . . . elimination of hand feeding . . . little or no fixturing . . . new standards for accuracy and finish.

In just 30 minutes we'll demonstrate in your plant how the Contour-matic® can reduce your machining costs—on your own work. Savings of 50%, 75%, even 90% are not unusual when you put your slotting, splitting, notching, trimming and facing operations on the table of a Contour-matic. Contours, angles and grinding reliefs are more production-line or toolroom operations now being done with the Contour-matic machine at a fraction of the time and cost of conventional methods.

Our in-plant demonstrations and "job spotting" are services your DoALL machine tool specialist provides without obligation. Let him help you make a realistic appraisal of your basic tools and machining methods. It will pay you to do it now. Call your local DoALL store today.

Typical jobs now spotted for Contour-matic machining



Productive Maintenance is your assurance of continuous, profitable performance on all DoALL machines. It is an included service to all DoALL users. Ask your DoALL representative about "Package Service."

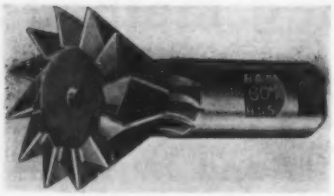
Find Your DoALL Store In The 'Yellow Pages'

B-55

This is a typical DoALL store.

The DoALL Company, Des Plaines, Ill.

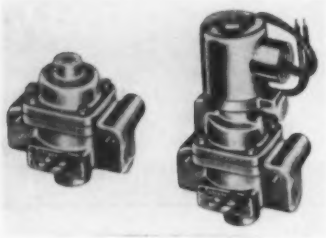
For more data, circle this page number on inquiry card



B&S Angular Cutter

New series 60-degree angular cutter of shank type introduced by the Cutting Tool Division, Brown & Sharpe Mfg. Co., Providence, R. I. This cutter is available in four new "standard" sizes: 3/4, 1 3/8, 1 7/8, and 2 1/4 inches, either individually or in a set, mounted in a wood block. These cutters are recommended for general milling of angles and dovetails especially where the arbors of arbor type cutters interfere with the workpiece or work area.

Circle Item 614 on postcard, page 171



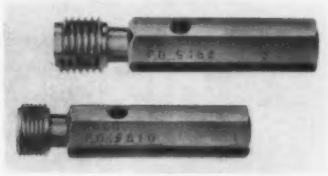
Three-Way Solenoid and Pilot Valves

Three-way solenoid valve and three-way pilot valve, both using the same type base and consisting of the same operating parts, introduced by A. Schrader's Son, Division of Scovill Mfg. Co., Brooklyn, N. Y. Fast interchangeability and a minimum requirement for spare parts result from these features. The pilot valve can be converted to a solenoid type by simply replacing the pilot chamber with the solenoid head, and vice versa. Another practical advantage is the conversion of either the pilot or solenoid valve from a normally open type model to a normally closed type valve, and vice versa, by merely shifting the pilot or solenoid chamber head 90 degrees. Both valves are of the heavy-duty type.

Circle Item 615 on postcard, page 171

"Black Diamond" Thread Plug Gages

"Black Diamond" thread plug gages featuring increased resistance to wear and abrasion intro-



duced by the Threadwell Tap & Die Co., Greenfield, Mass. Although priced the same as standard, steel thread plug gages, the Black Diamond gages in sizes No. 0 through 1 1/2 inches are said to have incredible hardness that increases wear life up to 300 per cent as a result of a specially developed surface treatment.

Circle Item 616 on postcard, page 171

Bausch & Lomb Safety Goggles

Cup type safety goggles of new line announced by the Bausch & Lomb Optical Co., Rochester, N. Y. This line includes a wide selection of protective eyewear in eight new models designed specifi-

cally for heavy industrial operations. Of improved design and construction, these goggles have been developed to assure the greatest degree of eye protection. Injection molded from tough thermoplastic, they have high impact resistance and their contour design guarantees safety and fitting comfort.

Circle Item 617 on postcard, page 171

Universal Select-O-Ring Kit

Kit of O-rings in sizes usually required for emergency or for planned replacement schedules offered by Bearings, Inc., Cleveland, Ohio. This universal Select-O-Ring Kit No. 2 contains 180 O-rings in sizes from 1 to 25. Surveys show that these sizes are used on 70 per cent of the

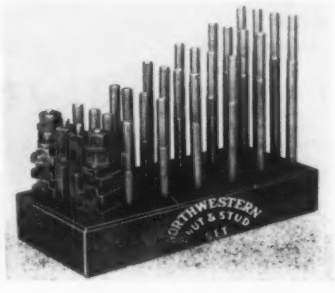
industrial equipment incorporating O-rings as sealing members. The plastic case serves as a gage for the O-rings.

Circle Item 618 on postcard, page 171

Hold-Down T-Nut and Stud Set

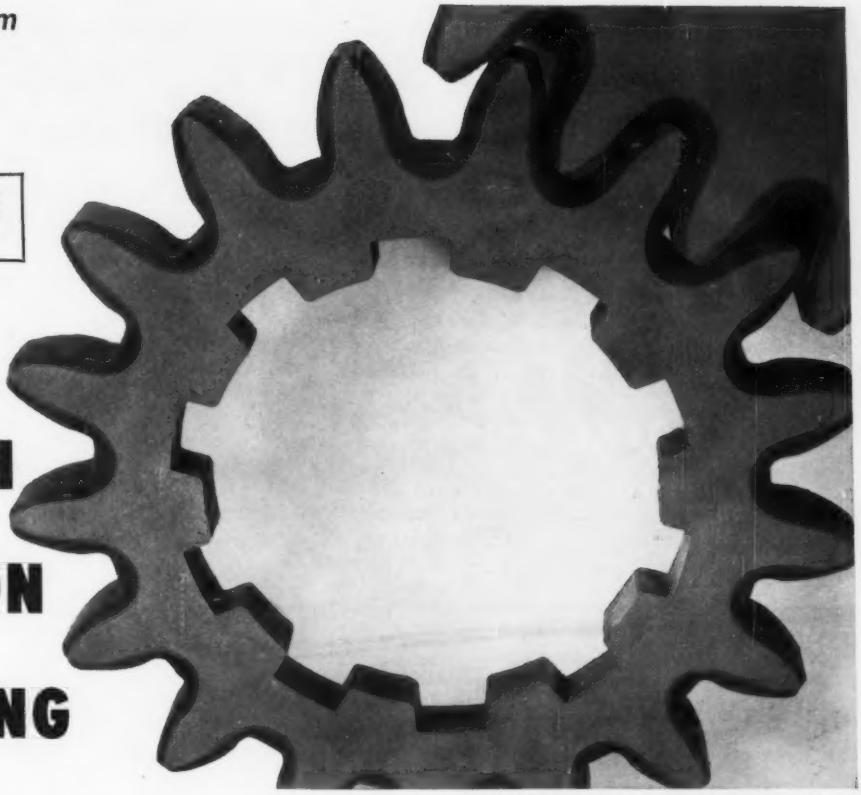
T-nut and stud set added to line of hold-down tools made by Northwestern Tools, Inc., Dayton, Ohio. Sets of this type are available for T-slots, in 3/8- through 1 1/16-inch widths. Each set includes: four each of 3-, 4-, 5-, 6-, 7-, and 8-inch studs, four flanged nuts, four coupling nuts, six T-nuts to fit machine, and a handy holder.

Circle Item 619 on postcard, page 171



at Farrel-Birmingham

NEW S&F TOOTH-TO-TOOTH INDUCTION HARDENING



Typical hardening pattern along flanks and through root.

...produces toughest gears yet!

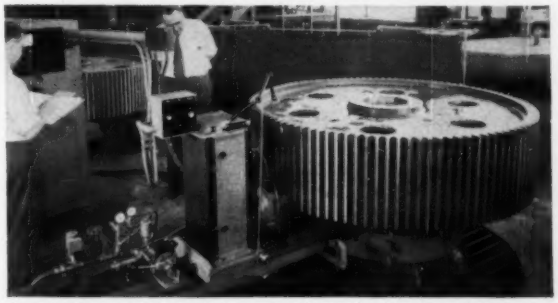
There's nothing like the S & F method of tooth-to-tooth gear hardening. Not only does it add amazing durability to big gears, but load-carrying capacity is vastly increased. Warpage can be insignificant depending on gear design. And there can be substantial savings in material and machining costs!

Farrel-Birmingham tells us that in one installation large gears with S & F induction-hardened teeth have already gone through over two years of rugged service with absolutely no sign of wear—whereas formerly, gears had to be *replaced* every two years. Reports of other installations are also highly satisfactory.

Precision controls maintain constantly accurate time, current, feed and distance between coil and workpiece to assure consistent results. In a group of similar gears, all portions of all teeth will have the same predetermined case contour and depth of hardness. In fact, hardening depth is so accurately controlled and warpage so minute that, for a number of gears, no additional machining is required.

S & F induction hardening units capable of handling gears from 3 in. to 20 ft. in diameter and larger, are available in semi-automatic and automatic models.

Want to know how this revolutionary approach to gear hardening can fit your production? Just ask us about it.



Spur, helical and double helical gears up to 157 in. diameter and 20 in. face widths are induction hardened tooth-by-tooth in this S & F equipment at Farrel-Birmingham, Ansonia, Conn.

KO CO., INC. PRECISION MACHINERY

KURT ORBAN COMPANY, INC.

42 Exchange Place, Jersey City 2, New Jersey

For more data, circle this page number on inquiry card

NOW — POSITIVE PRECISION

for all bore inspection operations

NEW Starrett No. 84

DIAL BORE GAGES

SENSITIVE, ACCURATE, EASY TO USE
Ideal for all bore inspection operations and for checking hole sizes during machining or grinding.

WIDE MEASURING RANGES — ONLY 3 SIZES NEEDED
Three sizes cover the range of 3 to 12⅛ inches. Models available reading in ten-thousandths or half-thousandths.

LIGHTWEIGHT, COMPACT, EASY TO HANDLE
Designed for extreme sensitivity, exact duplication of repetitive readings, easy handling, low maintenance costs.

STURDY CONSTRUCTION, DURABLE FINISH
Indicator housing and contact head made of finest aluminum with gray wrinkle finish. Knurled aluminum handle with black finish. Steel connecting tube with smooth black finish.

SELF-CENTERING IN BORE
Adjustable range screw with positive locking feature and two centralizing plungers give three-point contact for true alignment.

BUILT FOR LASTING PRECISION
Gaging contact and centralizing plungers inserted in bronze bushings, range screw in steel sleeve. Contact, range screw and plungers made of tool steel, hardened and tempered for long wear . . . also available carbide tipped on special order.

EASILY ADJUSTED FOR WIDE RANGE
Range screw adjustable to suit hole diameter and interchangeable for wide measuring range. Can be operated over full range without readjusting setting of gage housing on extension tube.

RELIABLE ON REPEAT READINGS
Gaging contact and centralizing plungers spring loaded for sensitivity and repeatability.

Your Industrial Supply Distributor will gladly demonstrate the advantages of Starrett No. 84 Dial Bore Gages. Call him for quality products, dependable service . . . or write for Bulletin No. 419. Address Dept. D. The L. S. Starrett Company, Athol, Massachusetts, U. S. A.

Starrett
World's Greatest Toolmakers

STARRETT TOOLS

PRECISION TOOLS • DIAL INDICATORS • STEEL TAPES • GROUND FLAT STOCK • HACKSAWS • HOLE SAWS • BAND SAWS • BAND KNIVES

NOMOGRAM CORRELATING ARC IN 0.0001 INCH, ANGLE IN SECONDS AND DEGREES, AND DIAMETER IN INCHES—1

Comparative measurement requires two separate operations: one consists of accurately positioning a surface to be used as a reference; the other is measuring, or sensing, the relative displacement from this reference. In angular measurement of gears, toothed or notched index wheels, and similar parts, an accurate angular positioning device is usually employed as a reference and errors are sensed as a linear displacement. Obviously, the accuracy of the positioning device and the accuracy of linear measurements of displacement should receive equal attention, since measurement results cannot be reliable beyond the sum of the maximum inaccuracies of both. Consequently, a description of measured accuracy is not complete unless it includes the order of accuracies in both systems which then could be converted into a single system for convenient comparison and evaluation.

The Nomogram on the following page provides a rapid means of conversion for this purpose. It is a simple straight-line alignment chart for a solution of the equation $N = 0.02424\ D\ ^{oe}$, when N is the arc expressed in 0.0001 inch, D = diameter in inches, and ^{oe} = angle in seconds. Given any two of the three variables, the third is read from the Nomogram as follows:

1. Locate the given values on their respective scale;
2. Connect these two points by a straight line;
3. The remaining unknown value is then read from the third scale at the point where this line intersects the scale.

This Nomogram enables the rapid conversion of angles to arc for a given diameter. It readily shows the extreme precision required for accurate angular positions for small diameters, both in production and inspection work.

It is very helpful in selecting inspection procedures and equipment. For example, assume that an angular positioning device that has a known accuracy of 5 seconds is available for inspection of a 3-inch diameter work-piece. If the errors in the linear system are to be kept consistent with this level of accuracy, it must be capable of measuring to within 0.000036 inch. If this is achieved, the total accuracy is within 5 seconds + 5 seconds = 10 seconds for the two systems. On an 8.5-inch diameter workpiece the linear system must be capable of measuring to within 0.0001 inch for a total accuracy of 5 seconds + 5 seconds = 10 seconds. Of course, if the accuracy of either system can be increased, the total accuracy is likewise increased.

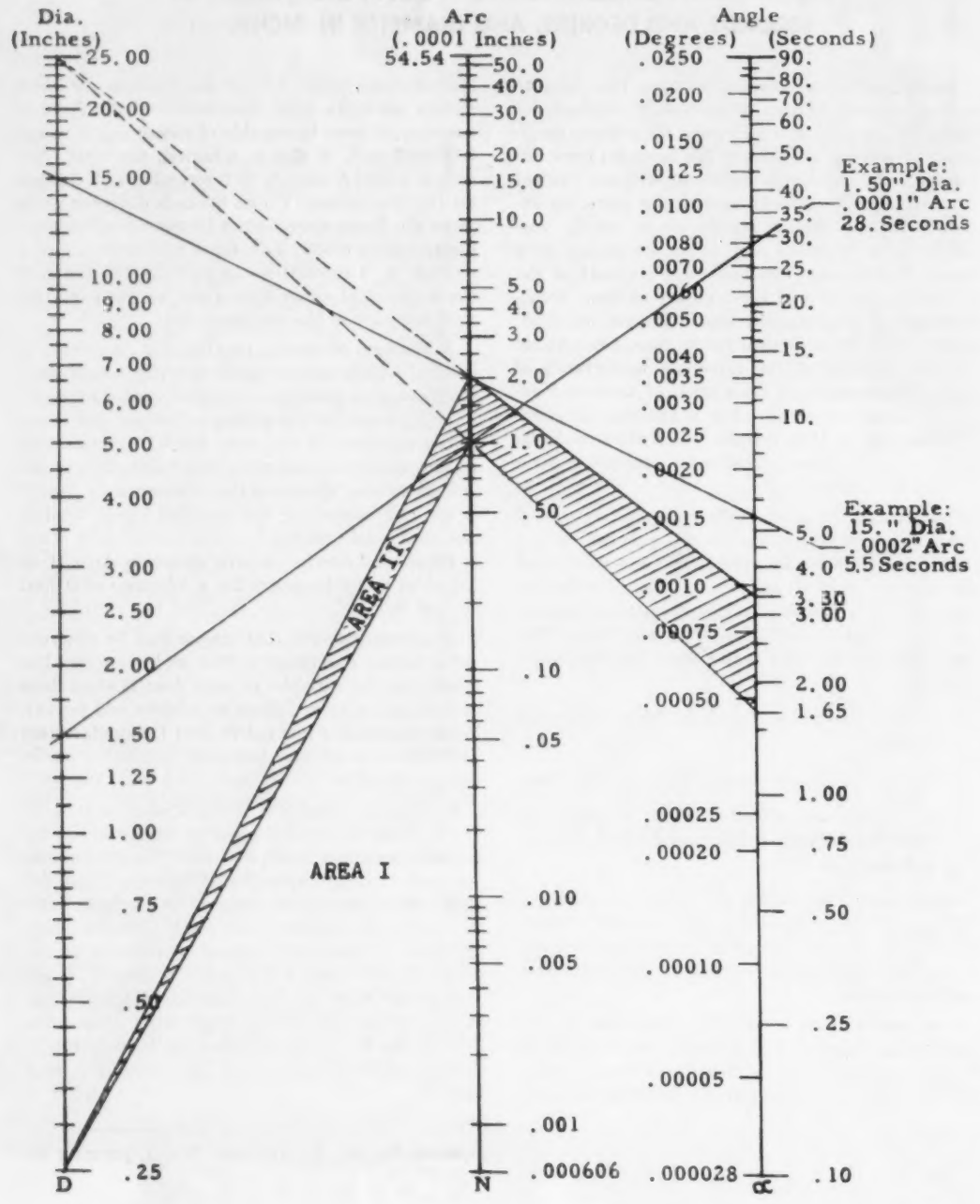
In the case of spacing requirements on toothed or notched wheels such as gears, indexing wheels, etc., the Nomogram provides a practical method for establishing a boundary for setting tolerances. For example, a tolerance of less than 0.0001 inch on total spacing on diameters of from 0.25 inch to 25.0 inches defines an area shown on the Nomogram as Area I. If the line connecting the variables passes through this area, a tolerance of less than 0.0001 inch of arc is required. Likewise an area shown as Area II on the chart sets a boundary for a tolerance of 0.0002 inch of arc.

It is recommended that utmost care be observed when setting specifications that will cause the line connecting the variables to enter Area II since these accuracies are very difficult to achieve and inspect. When the reading line enters Area I, manufacturing difficulties are extreme and even inspection results are questionable.

It should be noted that the equation $N = 0.02424\ D\ ^{oe}$ is linear in all three variables. Therefore, by the use of convenient multipliers, the Nomogram may be used to obtain solutions which would not fall within the range of the scales. For example, 0.020 on a 6.00-inch diameter circle can be brought within the range of the chart by using a multiplier of 100 on the N and ^{oe} scales. The points on the D, N, and ^{oe} scales are 6.00, 1.0, and 0.0019, respectively. Applying the multiplier 100 on the N and ^{oe} scales only, these values for a 6.00-inch diameter become $100 \times 0.0001 = 0.0100$ inch arc and $100 \times 0.0019 = 0.19$ degrees.

Anderson Duggar, Jr., Equitable Mfg. Engineering Co.

NOMOGRAM CORRELATING ARC IN 0.0001 INCH, ANGLE IN SECONDS AND DEGREES, AND DIAMETER IN INCHES—2



Anderson Duggar, Jr., Equitable Mfg. Engineering Co.

introducing a

NEW

OLOFSSON

HEAVY DUTY PRECISION BORING MACHINE

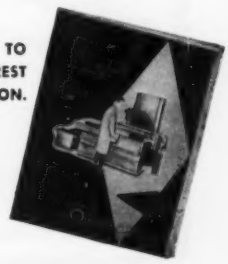
Designed for better precision finishing...semi-finishing...and roughing of large, bulky parts

This newest in the line of Olofsson Precision Boring Machines, the Model 22, is designed for more profitable heavy-duty rough and finishing boring, facing, chamfering, turning and grooving operations. Put one to work . . . and profit potential goes up. Because of the versatility of its new design, operating costs go down.

MODERN, WITH 22 QUALITY-DESIGN FEATURES, the Olofsson Model 22, weighs a hefty 7,600 lbs., untooled; and incorporates such design features as:

- *Extremely low ratio, height to width, of spindles to ways.*
- *Hardened and ground Alloy Steel flat and vee ways.*
- *Extra-large fixture mounting provides maximum stability for mounting large work pieces.*
- *Integral chip chutes completely surround any fixture tooling.*

WHATEVER YOUR PRODUCTION REQUIREMENTS. IT WILL PAY YOU TO FULLY INVESTIGATE THE MODEL 22. CONTACT YOUR NEAREST OLOFSSON REPRESENTATIVE. Or, if you prefer, write direct to OLOFSSON.

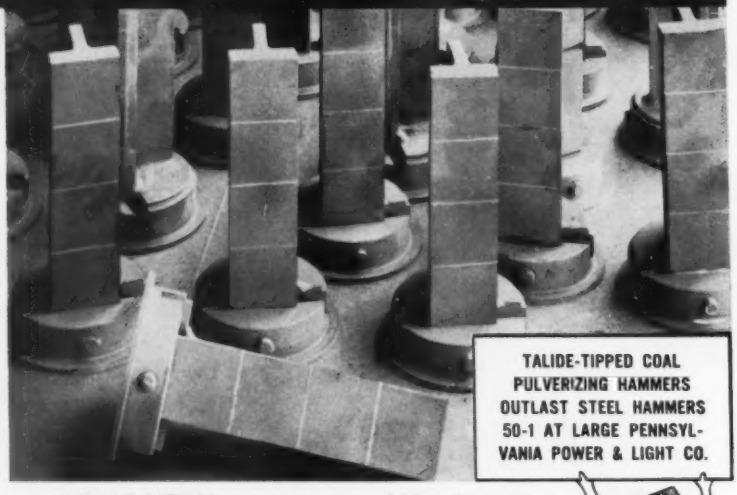


THE OLOFSSON CORPORATION

2729 LYONS AVENUE, LANSING, MICH. Phone: IVanhoe 4-5381

MANUFACTURERS OF PRECISION BORING AND SPECIAL MACHINERY

Outlasts Steel 50 to 1!



TALIDE-TIPPED COAL PULVERIZING HAMMERS OUTLAST STEEL HAMMERS 50-1 AT LARGE PENNSYLVANIA POWER & LIGHT CO.

• TALIDE METAL, a tungsten carbide of superior quality, is harder, stronger, and more resistant to abrasion than any other metal. Properly applied, it gives superior service on applications where wear, heat, strain and shock are destructive to other metals.

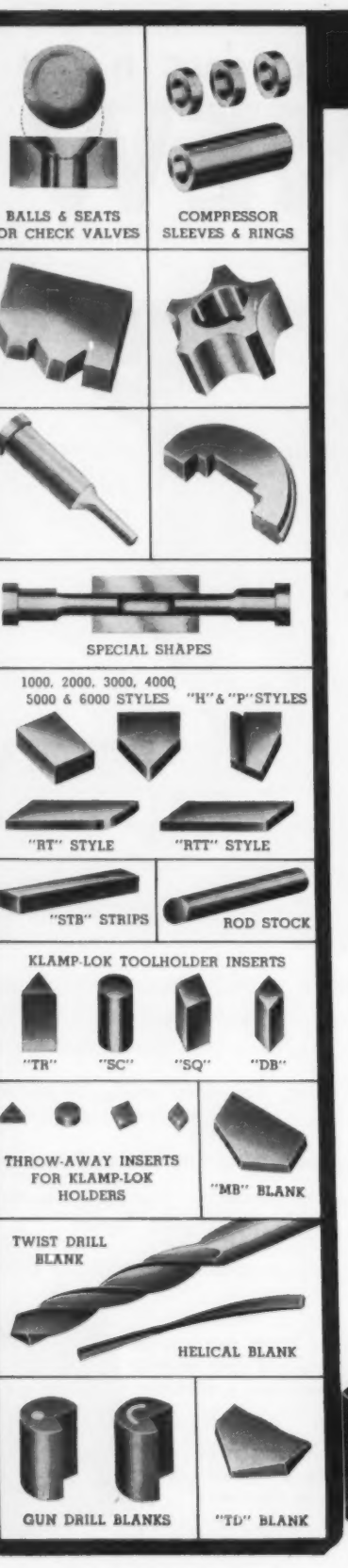
- **ABRASION RESISTANCE**—Up to 100 times that of steel.
- **COMPRESSIVE STRENGTH**—Higher than all melted, cast or forged metals and alloys.
- **RESISTANCE TO DEFORMATION**—2 to 3 times greater than steel.
- **HEAT RESISTANCE**—Resists oxidation and thermal shock up to 1500°F.
- **THERMAL EXPANSION**—Less than half the rate of steel, "creep" is negligible.
- **FRICTIONAL RESISTANCE**—Lower than steel, non-galling, "slippery" properties higher.

• TALIDE METAL is saving industry millions of dollars annually by wear-proofing vital parts on machine tools, presses, pumps, compressors and other types of processing equipment used in the steel, oil, chemical, plastic, auto, rubber, textile, glass, mining and metalworking industry. The physical properties of the most commonly used grades are listed below. Other grades are available for specialized applications.

PHYSICAL PROPERTIES OF TALIDE METAL (P. S. I.)

Application	Operation	Talide Grade	Rockwell "A" Hardness	Specific Gravity (Density)	Transverse Rupture Strength	Compressive Strength	Co-Efficient of Thermal Expansion	Modulus of Elasticity (Deflection)
WEAR SURFACE	No Shock	C-91	91.8	14.90	235,000	710,000	3.00 x 10-6	91,000,000
	Light Shock	C-99	91.0	14.75	265,000	670,000	3.65 x 10-6	84,000,000
	Medium Shock	C-88	89.5	14.55	295,000	635,000	4.00 x 10-6	80,000,000
IMPACT	Light	C-85	88.4	14.25	315,000	600,000	3.75 x 10-6	77,000,000
	Medium	C-80	87.0	13.85	335,000	550,000	4.50 x 10-6	74,000,000
	Heavy	C-75	85.0	13.15	355,000	500,000	5.00 x 10-6	70,000,000

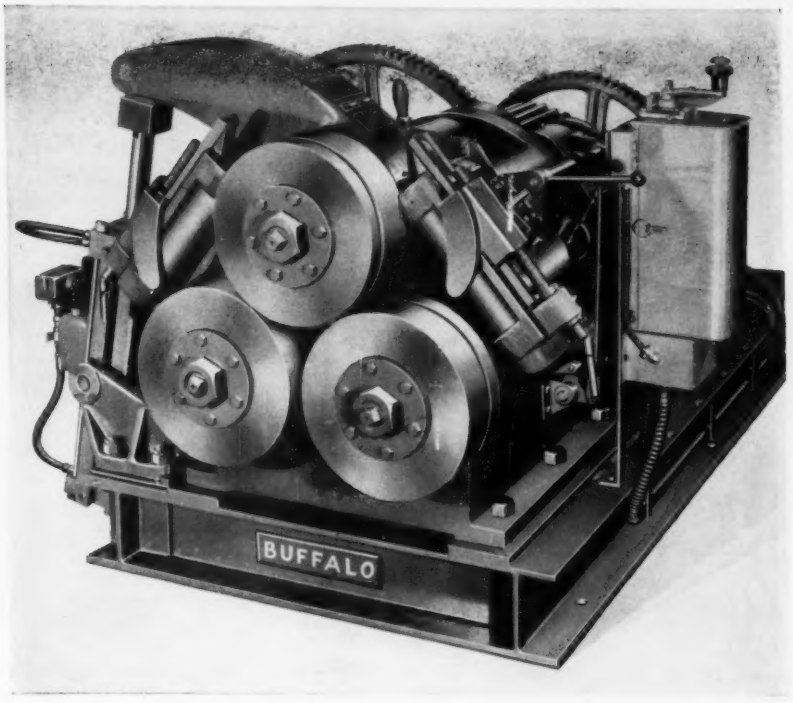
Note: Hardness values may vary plus or minus .2 to .3 on individual lots.



Metal Carbides Corporation
Youngstown 12, Ohio

Send for Catalog 56-G

Turn Your TOUGH Bending Jobs into PROFITABLE Operations with "BUFFALO" BENDING ROLLS



"Buffalo" Bending Rolls have taken production bending operations "out of the red" and put them "in the black" in literally hundreds of shops.

Fast, accurate and easily-operated, they are ideal for rapid circle, segment and spiral bending. Versatile, they handle angles, rounds, squares, tubes, beams, channels, flats and special shapes. Rolls are quickly and easily changed for different structural shapes and setup changes. With the unique "Buffalo" hydraulic adjustment for the top roll, the upper roll is effortlessly positioned or released to save vital setup time.

Exclusive "Buffalo" "Leg-In" Attachment saves you time and money! Difficult bending of angles leg-in is greatly speeded and simplified. Material will not twist or get out of square. This feature also acts as a gauge when rolling a number of circles to the same diameter.

Choose from a wide variety of "Buffalo" Bending Rolls in many sizes designed to handle a range of work from the heaviest members down to the smallest fabrication jobs. Call in your "Buffalo" machine tool dealer or use convenient coupon below.

"Buffalo" Machine Tools bring you the famous "Q" Factor — the built-in QUALITY which provides trouble-free satisfaction and long life.

ESTABLISHED 1877 "Buffalo" MEMBER N.M.T.B.A.

DRILLING
PUNCHING
SHEARING
BENDING

BUFFALO FORGE COMPANY

440 BROADWAY • BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

I'd like more information on how I can cut costs—increase profits with "Buffalo" Bending Rolls.

NAME _____ TITLE _____

FIRM _____

STREET _____

CITY _____ ZONE _____ STATE _____

For more data, circle this page number on inquiry card · · 195

By E. S. Salichs

BETWEEN GRINDS

A for XLO

Ex-Cell-O Corporation was recently awarded a bronze "Oscar of Industry" by *Financial World*, a national weekly magazine, for the best annual report entered in the machine tool industry category. An independent board of judges made the selection. Ex-Cell-Ent, Ex-Cell-O!

Aim the Same

Long ago, David Brown, one of the founders of Brown & Sharpe, traveled through New England with a horse and wagon demonstrating his wares. "Seeing is believing," still a good principle, was put to work this past year in modern form by Brown & Sharpe with the Mobile Precision Center. This showroom on wheels was scheduled to visit, by invitation, 1000 industrial plants in all 48 states. The idea was to give interested personnel a real chance to inspect and get the feel of precision products.

And No Monthly Bills

In one hour, the afterburner on the new tactical fighter-bomber, the Thunderchief, can deliver enough electrical energy to supply an average home for fifteen years, according to AiResearch Mfg. Division of the Garrett Corporation (which builds an air-turbine motor for the plane made by Republic Aviation). With how many TV's going at the same time?

Saved by Sharpener

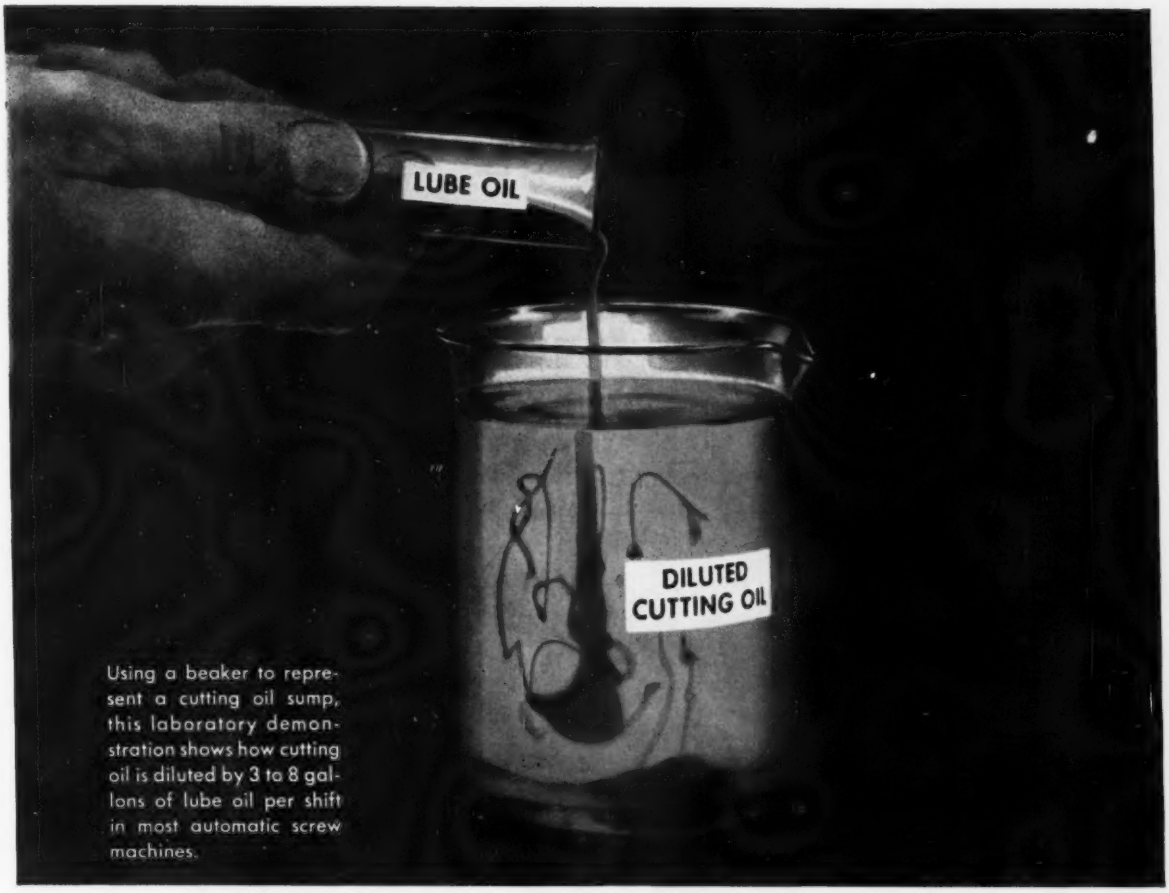
A booklet entitled "How to 'Ruin' a $50,000 Machine" by N. G. Cutting (get it?), released by the Heald Machine Co., depicts Precision Enemy No. 1, a cloaked saboteur who spoils expensive boring machines by using cutting tools with rough edges and irregular surfaces. But then our hero, the Heald Model 3 tool sharpener, steps in and foils the villain.

No Pix? In Fix!

Automobile drivers' licenses in South Carolina consist of Alcoa anodized aluminum tags, about the size of a calling card and punched to slip on key rings. Applications are photographed, the negatives being used to print the licenses on metalphoto plates. When stopped by an officer of the law, it should be easier to produce your metal tag than to fish through innumerable bent cards in your wallet.

MADISON INDUSTRIES INC. STILL AN ACTIVE CONCERN

In a news item published in December MACHINERY, page 214, the erroneous statement was made that Madison Industries Inc., which formerly operated a plant in Muskegon, Mich., was no longer in business. It has been learned that the company is now located in an expanded plant in a new location. The address is 560 Mineral Springs Ave., Pawtucket, R. I. A wider range of products is being manufactured than in the past. These products are being sold throughout the United States by the same representatives as in former years.



Using a beaker to represent a cutting oil sump, this laboratory demonstration shows how cutting oil is diluted by 3 to 8 gallons of lube oil per shift in most automatic screw machines.

It happens in 7 out of 10 automatics!

Diluted cutting oil can cut output 33%

No matter how careful your lubricating techniques, you still can't stop lube oil from leaking into the cutting oil sump on 70% of automatic screw machines. As cutting oil is diluted, it loses strength—ingredients that make it efficient become less and less effective. The natural consequence is shortened tool life, more downtime and a higher percentage of rejects.

Texaco Cleartex can end this problem forever. All you have to do is use Cleartex for both cutting *and* lubrication . . . and watch your production rise. The exceptional chemical stability and load-carrying ability of the Cleartex series make them equally suitable for use as cutting oils, lubricants and hydraulic fluids. (70% of all automatic screw machines can benefit from the "Cleartex Cure!")

TAKE THE CLEARTEX CURE SOON!

Write today for your copy of Texaco's new booklet—"Cleartex in Automatic Screw Machines." This new illustrated guide will fill you in on the details, show you where you may be losing profits and how to avoid it . . . Or contact your local Texaco Lubrication Engineer soon for an authoritative survey of your automatics. Just call the nearest of more than 2,000 Texaco Distributing Plants, or write to The Texas Company, 135 East 42nd Street, New York 17, New York. Dept. MA-10.

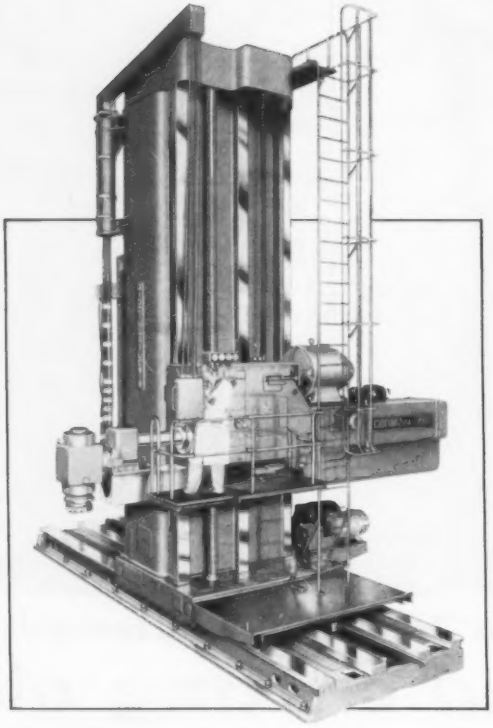
TUNE IN...Metropolitan Opera Radio Broadcasts Every Saturday Afternoon

LUBRICATION IS A MAJOR FACTOR IN COST CONTROL

(PARTS, INVENTORY, PRODUCTION, DOWNTIME, MAINTENANCE)

For more data, circle this page number on inquiry card

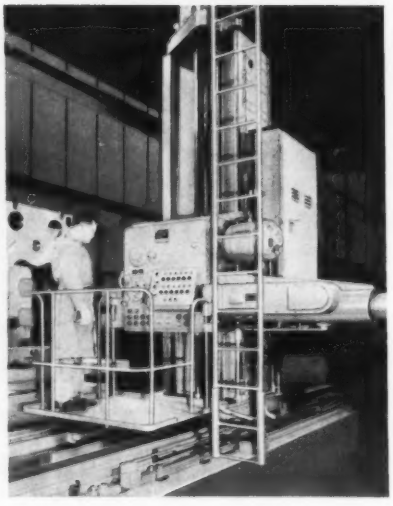
Ideas on tooling for cost reduction



NEW. Designed to reduce the cost of heavy drilling, large-hole boring, and heavy milling on huge workpieces, G&L's new 8″ or 10″ spindle 80 Series machines feature more than 20 feet of vertical headstock travel.

Machines are available with an underarm; cross-sliding column; or a planer-type table.

Giddings & Lewis offers table-, floor-, and planer-type horizontals with spindle diameters ranging from 3″ through 14″ and with electronic controls for template tracing, numerical positioning, or numerical contouring. ASK FOR CATALOG 80-F.



NEW. This tape-controlled automatic horizontal boring, drilling, and milling machine has effected a 30% direct cost reduction in machining printing press parts. Big additional savings come from elimination of jigs and fixtures. The simple, punched paper tape control system repeats with high accuracy. These 4″ or 5″ dia. spindle machines also can be operated by manual pushbutton or digital dial control. A product of G&L's Kaukauna Division. ASK FOR CATALOG H-6.

All these operations, and more—for faster machining, less handling, fewer setups, with versatile G&L horizontal bars

Backfacing with continuous feed facing head.

Turning and boring with continuous feed facing head.

GL-100

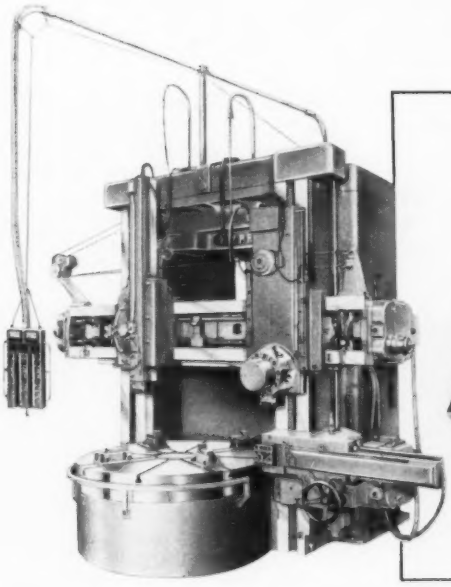
with new multi-purpose Giddings & Lewis machines

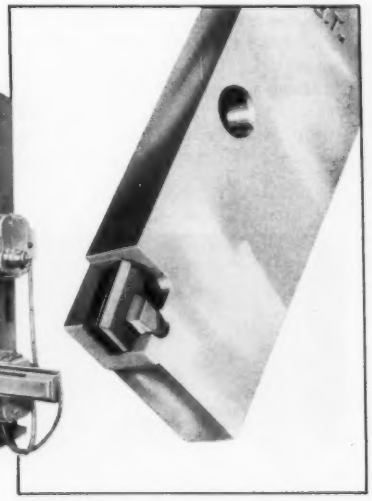
Pictured here are a few of the opportunities for reducing workhandling—for multiple tooling—and for combining on one machine jobs commonly routed to two or more different machines.

Faster and fewer setups—faster machining—fewer nonproductive operations—easier, faster operation—quicker tool changes—and increased machine utilization are among the factors that warrant your full investigation of G&L equipment. Call your G&L distributor, or write.

GIDDINGS & LEWIS

Giddings & Lewis Machine Tool Company, Fond du Lac, Wisconsin

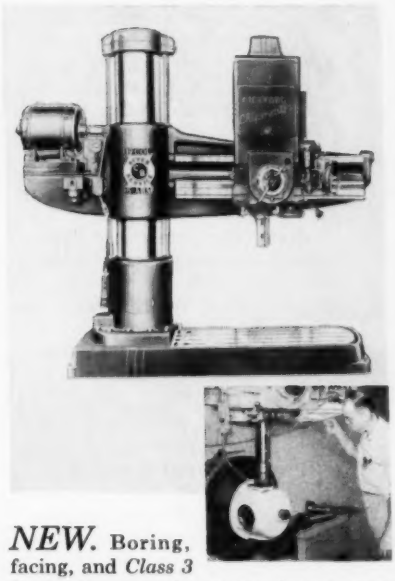




NEW. A vertical boring and turning mill with speed and control that put it out in front for cost reduction. Complete remote control from a pendant station includes preselect of all ram and saddle feeds. Optional constant cutting speed increases tool life, reduces downtime—table speed changes made without stopping or changing gear. Table diameters from 54″ to 14′. Tracer or magnetic tape control available. ASK FOR CATALOG VBM-4.

NEW. With Davis throwaway tip block cutters for your STANDARD Davis block-type bars, tool costs can be reduced and production increased. Here's why: (1) instant tip indexing with minimum downtime; (2) carbide grinding eliminated; (3) low cost per cutting edge—eight edges on negative rake tool, four on positive rake tool; (4) less tool inventory required.

This is a development of G&L's Davis Boring Tool Division. ASK FOR BULLETIN DB-410.

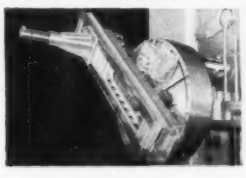


NEW. Boring, facing, and *Class 3 thread tapping* of a 5″ dia. hole in 1½ minutes on the Chipmaster radial—12.5% the previous machining time!

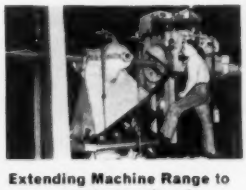
Product of G&L's Cincinnati Bickford Division, the all-new Chipmaster has preloaded bearing spindle to take severe thrust loads of heavy boring, spade drilling, and facing. Instant spindle reversal at speeds to 2300 rpm cuts tapping costs. 4′—13″ to 8′—19″ sizes. ASK FOR CATALOG R-35.

Keyway Cutting with underarm and shaper head.

Boring and Turning Diameters up to 150″ with tool on face plate drive.



Angular Milling attachment mounted on underarm.



Extending Machine Range to save repositioning of work.

News OF THE INDUSTRY

Georgia and North Carolina

LEONARD W. WAGNER has been appointed Augusta district manager by PANGBORN CORPORATION, Hagerstown, Md. Mr. Wagner will direct over-all sales activities and field engineering services from the district headquarters at 1317 Buena Vista Road, Augusta, Ga.

LONNIE L. HOLDER has been promoted by Wysong & Miles Co., Greensboro, N. C., to sales manager of the Metalworking Machinery Division.

Illinois and Wisconsin

JOHN W. TOUHY has been promoted to assistant sales manager of WILTON TOOL MFG. CO., INC., Schiller Park, Ill. He will continue his field-sales supervisory work, and will also be in charge of sales correspondence.

GORDON M. SOMMER was named vice-president in charge of engineering for CLEARING MACHINE CORPORATION, Division of U. S. Industries, Inc., Chicago, Ill. He has been director of research and development at the company for two years.

Gordon M. Sommer, vice-president in charge of engineering, Clearing Machine Corporation, U. S. Industries, Inc.

GREENLEE BROS. & CO., Rockford, Ill., announce the purchase of the BUSS MACHINE WORKS and its subsidiary, B & T MACHINERY CO., both in Holland, Mich. Their acquisition of B & T Machinery Co. adds a new line of die-casting machines to the Greenlee line of standard and special machine tools. Sales departments of the two companies will be combined. Management and operation of the two subsidiaries will continue under the direction of JAY H. PETTER, vice-president and general manager, and JAY C. PETTER, vice-president and chief engineer of Buss Machine Works, Inc., Holland, Mich.

Tom Carroll, vice-president—sales, Dumore Co.

The DUMORE CO., Racine, Wis., announced the following appointments: TOM CARROLL has been made vice-president in charge of sales and HARRY WARDRIP has been promoted to sales manager. Mr. Wardrip will supervise the coordinated sales activities for the company on its three major lines. Both Mr. Wardrip and Mr. Carroll will operate out of the Dumore plant, 1300 Seventeenth St., Racine.

SUNDSTRAND MACHINE TOOL CO., Rockford, Ill., has announced acquisition of the Machinery Division of Hanson-Whitney Co., Hartford, Conn. The transaction covers manufacturing and sales rights to Hanson-Whitney thread-milling machines and does not include any other products made by the eastern company. Machines in the line will be manufactured at Sundstrand's plant in nearby Belvidere.

JOSEPH T. RYERSON & SON, INC., Chicago, Ill., has appointed JOHN W. BODWELL and ROBERT T. HARVEY as assistant general managers of sales with headquarters in the company's general offices. In addition to their new duties, Mr. Bodwell will continue to be responsible for work order sales and Mr. Harvey will retain responsibility for aluminum sales.

Michigan

METALLURGICAL PRODUCTS DEPARTMENT, General Electric Co., Detroit, Mich., announces that distribution of draw, heading, and extrusion dies will be through authorized Carboloy die distributors on a regional basis. The department will no longer manufacture fabricated dies. However, arrangements have been made to service die customers in areas where there are no die distributors at present. Two of the new distributors, ALLIED CARBIDE PRODUCTS, INC., formerly of Hatboro, Pa., now situated in Jamaica, Long Island, N. Y., and BRONSON & BRATTON, Chicago, formerly were agents for the General Electric unit. A new company is GLEN CARBIDE, INC., Pittsburgh, Pa. EARLE GLEN, currently manager of die sales, will leave the Metallurgical Products Department to establish Glen Carbide, Inc., and will be distributor in the Pittsburgh area. Glen also will take over the Pittsburgh die service shop previously owned by Metallurgical Products Department. C. W. MARTIN and DOUGLAS E. HAZLETT, die sales representatives with the Department, will become members of Glen's firm in the same capacity. W. K. FACKNITZ will become die specialist in the Detroit headquarters to work with distributors and coordinate sales activities.

MOST USEFUL HAND SCREW MACHINES ON THE MARKET

... the Brown & Sharpe Nos. 00, 0, and 2

You can handle the widest range of short run work and second operations, with highest productivity and economy, on Brown & Sharpe Hand Screw Machines. They provide the same spindle speed versatility as B&S Automatics: 196 2-speed combinations, providing a wide range of high to low ratios. In addition, they use the same tools, collets, and fingers as equivalent-size B&S Automatics — set-ups are exactly the same! Operation is easy too. For example: A convenient lever controls both high and low spindle speeds, and braking. "Natural position" turret control reduces operator fatigue. A handy trip-lever controls chucking and bar feed. For highest efficiency and economy, put your short runs and make-up jobs on B&S Hand Screw Machines. *Write for details.*

Brown & Sharpe Mfg. Co.,
Providence, R. I.

- *Greatest number of spindle speed combinations*
- *Exclusive tool interchangeability with B&S Automatics*
- *Easiest to set up and operate*

Brown & Sharpe

B·S

No. 0
Hand Screw
Machine

Joseph F. Wrobel, sales manager, F. Jos. Lamb Co.

JOSEPH F. WROBEL has been appointed sales manager of the F. Jos. LAMB CO., Detroit, Mich. Mr. Wrobel, who joined the company in 1955, has over sixteen years experience in the machine tool industry, having held positions in engineering, manufacturing, service, and sales.

BUHR MACHINE TOOL CO., Ann Arbor, Mich., announces the appointment of HARRINGTON-WILSON-DAUM CORPORATION to represent the company for its complete line in the eastern portion of New York, northern New Jersey, and Connecticut. Home office of the new distributor is at 25 Beechwood Ave., Mount Vernon, N. Y., with a branch office at 62 LaSalle Road, West Hartford, Conn.

MICHIGAN TOOL CO., Detroit, Mich., announces that IRVIN R. SPANGLER has been appointed sales manager for the Machine and Tools Division. Mr. Spangler takes over from PAUL F. ZERKLE, who will continue as a member of the executive staff working on special assignments.

PIONEER ENGINEERING & MFG. CO., Detroit, Mich., announced the acquisition of all of the assets of WETTLAUFER ENGINEERING CORPORATION, Detroit. ELMER WETTLAUFER, former president and founder of Wettlaufer, becomes a member of the Pioneer board of directors.

AUTOMATION SERVICES, INC., Detroit, Mich., has announced the formation of its Hydra-Blast Mfg. Division to handle wet-blasting machines, abrasives, and related supplies.

The name of SNYDER TOOL & ENGINEERING CO., Detroit, Mich., has been changed to SNYDER CORPORATION in order to avoid misconceptions about the type of equipment the company manufactures.

New England

VEEDER-ROOT INC., Hartford, Conn., has elected HARVEY L. SPAUNBURG chairman of the board and WILBUR C. STAUBLE president. ANDREW J. REBMANN, vice-president and secretary, was elected to the board. Mr. Stauble will continue in his position of president of Holo-Krome Screw Co., a wholly owned subsidiary of Veeder-Root. ARTHUR E. KALLINICH, vice-president of Veeder-Root, was appointed to the board of Holo-Krome to fill the unexpired term of JOHN H. CHAPLIN, deceased. Mr. Kallinich is in charge of catalogue sales.

PRATT & WHITNEY CO., West Hartford, Conn., has made the following appointments: HARRY B. RANDALL, JR., has been appointed district manager of the company's New York office. He will also head the company's branch office in Livingston, N. J. KENNETH H. CONNOLLY and WILLIAM A. DINGER have been named to the post of sales supervisor. Both will supervise cutting tool and gage sales—Connolly in the New York area and Dinger in the New Jersey area.

HAMILTON STANDARD, Division of United Aircraft Corporation, Windsor Locks, Conn., has appointed ARVID NELSON assistant to the general manager. ERMANO GARAVENTA succeeds Mr. Nelson as factory manager. Mr. Nelson will be responsible for broad studies and recommendations concerning division-wide control of product costs and for specific assignments involving individual products and parts. Mr. Garaventa will be responsible for all manufacturing operations of the division, as well as all engineering, and materials control.

CUTTING TOOL DIVISION, Brown & Sharpe Mfg. Co., Providence, R. I., has made two new appointments. RALPH C. ANDERSON is assigned to the greater Milwaukee area with headquarters in the Chicago office. WILLIAM H. YATES will cover the lower Connecticut area, which also includes Long Island.

ROY C. NORTON, JR., has been named chief engineer of the recently formed SACO-LOWELL AUTOMOTIVE DIVISION of Saco-Lowell Shops, Boston, Mass. He will be located at the new Edwards plant in Saco, Me.

New York, New Jersey, and Pennsylvania

LIPE-ROLLWAY CORPORATION and ROLLWAY BEARING CO., INC., Syracuse, N. Y., announce the following executive changes: JOHN D. WILLIAMS has been elected president. He succeeds H. FOLLETT HODGKINS, SR., who becomes chairman of the board. Other changes include the appointment of ROBERT M. ZIMMERMAN to the post of vice-president, Lipe-Rollway Corporation. H. FOLLETT HODGKINS, JR., has been named vice-president of Rollway Bearing Co., Inc., a wholly owned subsidiary.

(Left) John D. Williams, president, and (right) H. Follett Hodgkins, Sr., board chairman, Lipe-Rollway Corporation and Rollway Bearing Co., Inc.

UNION CARBIDE CORPORATION, New York City, announced the following changes in management: MORSE G. DIAL, president, assumes the newly created office of chairman of the board and continues as chief executive officer; HOWARD S. BUNN, executive vice-president, becomes president; and BIRNY MASON, JR., vice-president, becomes executive vice-president. Mr. Mason and KENNETH RUSH, vice-president, have been added to the board of directors.

LINDE COMPANY, Division of Union Carbide Corporation, New York City, announced the appointment of LEO I. DANA as vice-president—technology and DAVID SWAN, vice-president—research. Mr. Dana's primary responsibility will be to evaluate Linde's technical program and Mr. Swan will be responsible for the research and development activities of Linde's laboratories in Tonawanda, N. Y., and Speedway, Ind.

WARNER & SWASEY RESEARCH CORPORATION, Cleveland, Ohio, has just been made the Control Instrument Division of the parent company under the direction of manager W. S. TANDLER. Headquarters for sales engineering and manufacturing of the division are at 34 W. 33rd St., New York City.

OAKITE PRODUCTS, INC., New York City, has named REGINALD R. BURNS director of purchases and WILLIAM M. BOARDMAN purchasing agent. Mr. Burns will continue to be responsible for production planning, and will have charge of the company's purchasing activities.

AIR REDUCTION SALES CO., a Division of AIR REDUCTION CO., INC., New York City, has announced the establishment of a Special Products Department. CHARLES I. MACGUFFIE has been appointed manager of the new department, and J. E. BERRYMAN has been named general sales manager.

JOHN F. CAIN was elected director and named general manager of GREER HYDRAULICS, INC., International Airport, Jamaica, N. Y.

ARTHUR H. HANSEN has been named sales manager of HALVORSEN BEARINGS, INC., Brooklyn, N. Y.

GLEASON WORKS, Rochester, N. Y., announces that LAWRENCE C. GLEASON was elected president to succeed E. BLAKENEY GLEASON, who died in November. Other appointments announced were DWIGHT VANDEVATE, general manager; RANDOLPH E. CARSON, secretary-treasurer; and RAYMOND W. DOELL, director.

(Left) Lawrence C. Gleason, president, and (right) Dwight VandeVate, general manager, Gleason Works

AMERICAN COLDSET CORPORATION, Tool and Wheel Division, Teterboro, N. J., has announced the following appointments as sales representatives: M. E. CLARK will cover northern Connecticut, all of Massachusetts, Maine, New Hampshire, and Vermont, with headquarters at North Granby, Conn. CUMMINS MACHINERY CO. will act as representative in parts of Georgia, with headquarters at 182-184 Courtland St., N. E., Atlanta. W. E. MILLER will service parts of eastern Pennsylvania and all of southern New Jersey, with headquarters at 11 Orchard Lane, Levittown, Pa.

EDWARD C. PETERSON has been elected to the Board of Directors of the Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa. The new director is vice-president of the company's Rolling Mill Equipment Division. Mr. Peterson joined Birdsboro Steel in 1940 as assistant to the secretary and treasurer, and has progressed to his present position after serving the company in diverse capacities.

Edward C. Peterson, elected to the Board of Directors, Birdsboro Steel Foundry & Machine Co.

THOMAS D. BURLEY has been named to the newly created post of manager of high-temperature steel sales for the Carpenter Steel Co., Reading, Pa.

HENRY J. EGEN, JR., has been appointed manager—tool engineering and metal fabrication for PHILCO CORPORATION, Government and Industrial Division, Philadelphia, Pa.

Ohio

JOSEPH T. RYERSON & SON, INC., Cincinnati, Ohio, announces the following new appointments at its Cincinnati steel service plant. ALBERT H. BADER, former manager of the general order department, was appointed assistant to the general manager. NORMAN R. MILLER, former manager of the work order department, was named manager of the general order and merchandise procurement departments. Succeeding Mr. Miller as manager of the work order department is THEODORE G. MATES. LOUIS G. BRINKER of the procurement and merchandise departments was appointed supervisor of merchandise records.

GEORGE C. MORGAN has been named vice-president of the G. A. GRAY CO., Cincinnati, Ohio. Mr. Morgan will devote his efforts primarily to the sales area.

THE SHEFFIELD CORPORATION, Dayton, Ohio, announces its acquisition of the drill-making facilities of COGSDILL TWIST DRILL CO., INC., Detroit, Mich., and transfer of sales and manufacturing to Greenfield, Mass. STEWART COGSDILL will act as consultant to the Cogsdill Twist Drill Co. of Greenfield, and Roy HELDENBRAND will operate the plant as general manager.

THE UNIVERSITY OF CINCINNATI, Cincinnati, Ohio, has appointed HANS ERNST, internationally known research engineer, to a new campus position as the Herman Schneider Research Professor in the College of Engineering. For thirty-two years director of research at the Cincinnati Milling Machine Co., Professor Ernst retired in November 1957 and is now the company's research consultant.

LOUIS F. POLK, vice-president and group executive of Bendix Aviation Corporation and president of the Sheffield Corporation, Dayton, Ohio, was elected president of the American Ordnance Association at the annual meeting of the Association's board of directors.

Obituaries

GEORGE E. GERNON, secretary of the Gisholt Machine Co., Madison, Wis., died October 16, 1958, at the age of eighty-seven after fifty-eight years of continuous service to the company. After practicing law in the Dakotas until 1900, he came to Gisholt to handle the legal affairs of the company. On August 9, 1905, he was named company secretary, a position he had held for fifty-three years at the time of his death. He was an active member of the Gisholt board of directors until 1954 and an honorary director until his demise.

George E. Gernon

EMMET BLAKENEY GLEASON, president of Gleason Works, Rochester, N. Y., died on November 21, 1958, in New York City at the age of fifty-five. Mr. Gleason was also treasurer and general manager of the firm. In 1929 he joined the company founded by his grandfather and was made a program engineer in 1932. He progressed steadily to the presidency of the firm in 1947. He was a member of the War Production Board during World War II. Mr. Gleason was active in Harvard Clubs of Rochester, Boston, and New York, as well as community affairs.

Emmet Blakeney Gleason

New Books

AIDS TO EFFICIENT MACHINE DESIGN IN WELDED STEEL. 50 pages; illustrated; 8 1/2 by 11 inches. Published by the Lincoln Electric Co., 22801 St. Clair Ave., Cleveland 17, Ohio. Price, $1.00.

This manual is for machine designers who wish to improve their machines through the efficient use of welded-steel design. Twelve chapters cover a variety of subjects in this category. They include methods for redesigning cast bases and flywheels for lower costs; ways to design bearing supports, fillet welds for strength, for bending or twisting, for horizontal shear due to bending, etc.

AMERICAN DRAFTING STANDARDS MANUAL, ASA B5.28-1958. Mounting Dimensions of Lubricating and Coolant Pumps for Machine Tools. 11 pages; illustrated; 8 1/2 by 11 inches. Published by the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y. Price, $1.00.

This booklet, another in the series of manuals published by the ASME, is the work of Sectional Committee B5 on Standardization of Small Tool and Machine Tool Elements. It is concerned with foot-, bracket-, and motor-mounted pumps. Line drawings are presented.

Coming Events

JANUARY 12-16—Annual Meeting and Engineering Display, Society of Automotive Engineers, at the Sheraton-Cadillac and Hotel Statler, Detroit, Mich. Contact Robert W. Crory, Public Relations Manager, SAE, 485 Lexington Ave., New York 17, N. Y.

MARCH 11-13—Tenth Anniversary Spring Technical Meeting to be held at the Pick-Congress Hotel, Chicago, Ill. For further information write Pressed Metal Institute, 3673 Lee Road, Cleveland 20, Ohio.

MARCH 16-20—Western Metal Show to be held at Pan-Pacific Auditorium, Los Angeles, Calif. Contact American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio.

MARCH 19-20—National Production Meeting, Society of Automotive Engineers, to be held at the Sheraton-Cadillac, Detroit, Mich. Contact Robert W. Crory, Public Relations Manager, SAE, 485 Lexington Ave., New York 17, N. Y.

APRIL 18-22—ASTE Annual Meeting to be held at the Schroeder Hotel, Milwaukee, Wis. Contact American Society of Tool Engineers, 10700 Puritan Ave., Detroit 38, Mich.; Harry E. Conrad, executive secretary.

Will Help Control Enormous Volumes of Steam

This odd-shaped forging is as husky and rugged as it looks. It's an interceptor valve body, made of electric-furnace alloy steel, and it's going to be pitted against the forces of steam. The finished valve will be one of the flow-control units in a big turbine system.

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Product Directory

To find headings easily, look for capital letters at top of each page to denote location.

ABRASIVE CLOTH, Paper and Belt
Crane Packing Co., 6400 Oakton St., Morton Grove, Ill.
Gardner Machine Co., Beloit, Wis.
Norton Co., 1 New Bond St., Worcester, Mass.
Norton Co., 1 Bond St., Worcester 6, Mass.

ABRASIVES, Disc
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.

ABRASIVES, Polishing, Tumbling, Etc.
Crane Packing Co., 6400 Oakton St., Morton Grove, Ill.

ACCUMULATORS, Hydraulic
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.

Here is a completely new electric-hydraulic forcing and straightening press, with construction and operating advantages never before offered in a low-cost shop press.

These are a few of the features:

- **Rapid Ram Approach** — Automatically changes to power stroke when it contacts the work.
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AIR GUNS
Chicago Pneumatic Tool Co., New York 17, N. Y.
Schrader's Sons, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.

AIR TOOLS—See Grinders, Portable, Pneumatic—Drills, Portable, Pneumatic, Etc.

ALLOY STEELS
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Ryerson Joseph T., & Son, Inc., 2558 W. 16th St., Chicago 18, Ill.
U. S. Steel Corp., Carnegie-Illinois Steel Corp. Div., 436 7th Ave., Pittsburgh, Pa.
Vanadium Alloys Steel Co., Latrobe, Pa.
Wheelock, Lovejoy & Co., Inc., Cambridge, Mass.

ALLOYS, Bearing
Bunting Brass & Bronze Co., 715 Spencer, Toledo 1, Ohio
Carpenter Steel Co., 105 W. Bern St., Reading, Penna.
Mueller Brass Co., Port Huron, Mich.

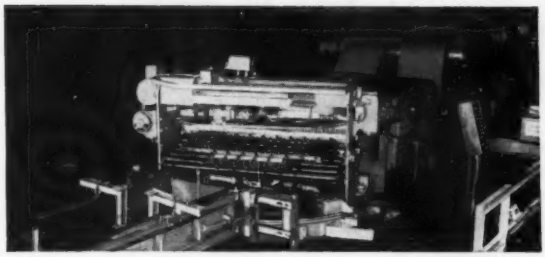
ALLOYS, Non-ferrous—See Brass, Copper, Zinc and Stellite

ALUMINUM and Aluminum Products
Mueller Brass Co., Port Huron, Mich.
Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y.
Ryerson & Son, Jos. T., 16th & Rockwell Sts., Chicago 8, Ill.

ANGLE PLATES—See Set-Up Equipment

ANNEALING FURNACES
Eisler Engrg. Co., 750 So. 13th St., Newark 3, N. J.

Cincinnati® Shear swivels for mitre cuts at Budd



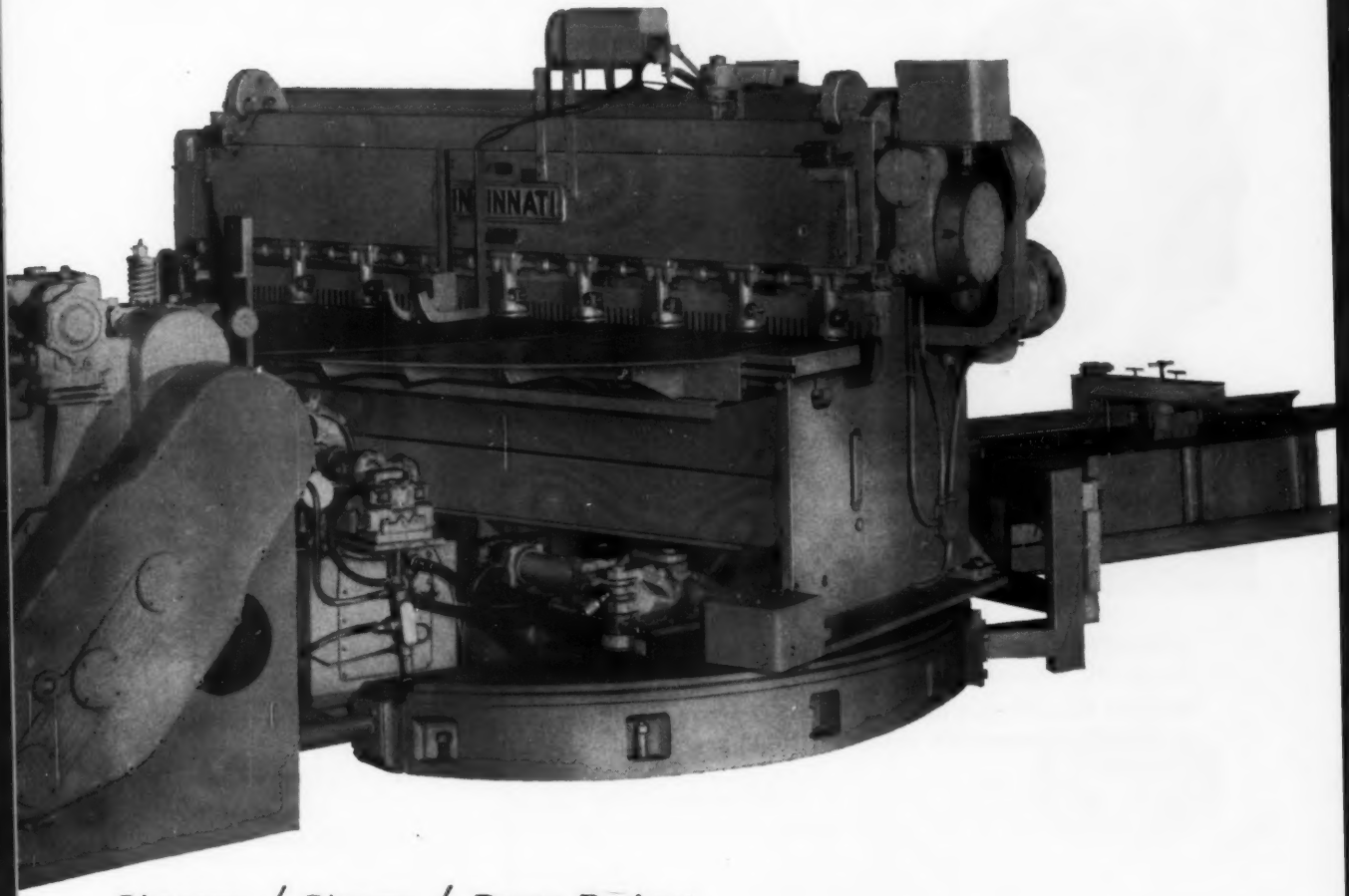
This Cincinnati® Shear is an integral part of an automatic decoil and shear line at The Budd Company's Gary, Ind., plant. It is used for straight and mitre shearing of coil stock into sheets.

Mounted on a swiveling base, the shear can be rotated 22½° to either side of center, so the operator can pre-set the desired angle of cut.

Accuracy must be within ⅛″ per 80″ of feed. Sheet widths range from 24″ to 72″ and thickness from 21 to 16 gauge (.0349″ to .0625″). Since the operation must be automatic and continuous to be economical, Cincinnati dependability is a vital asset.

This shear was specially engineered for The Budd Company. However, most of its profitable features are available with standard Cincinnati® Shears. They include powerful hydraulic hold downs, all-steel interlocked construction, and one-clearance shearing of different metal thicknesses.

Complete details on Cincinnati® All-Steel Shears are included in Catalog S-7R. Write to Dept. D.



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ARBORS AND MANDRELS
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Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland, Ohio
Jacobs Mfg. Co., West Hartford, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Logansport Mch. Co., Inc., Logansport, Ind.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio
Supreme Products, Inc., 2222 S. Calumet Ave., Chicago 16, Ill.

ARC WELDERS—See Welding Equipment, Arc

ASSEMBLING MACHINES
Detroit Power Screwdriver Co., 2799 W. Fort St., Detroit 16, Mich.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Sheffield Corp., Box 893, Dayton 1, Ohio

AUTOMATIC SCREW MACHINES—See Screw Machines, Single and Multiple-Spindle Automatic

BABBITT
Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

BACTERICIDES
Lilly, Eli and Co., Indianapolis 6. Ind.

BALANCING EQUIPMENT
Balance Eng. Co., 5024 W. Lake St., Chicago 44, Ill.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gisholt Machine Co. (Static and Dynamic), 1245 E. Washington Ave., Madison 10, Wis.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sundstrand Mach. Tool Co., 2531 11th St., Rockford, Ill.

BALLS
Bearings, Inc., 3634 Euclid Ave., Cleveland 15, Ohio
Hoover Ball & Bearing Co., Ann Arbor, Mich.

BAR MACHINES—See Screw Machines, Single and Multiple-Spindle, Automatic

BAR STOCK, Non-ferrous
Bunting Brass & Bronze Co., 715 Spencer, Toledo, Ohio
Mueller Brass Co., Port Huron, Mich.
Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

BAR STOCK AND SHAFTING, Steel
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Boston Gear Works, 14 Hayward St., Quincy 71, Mass.
Carpenter Steel Co., 105 W. Bern St., Reading, Penna.
Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

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Bearings, Inc., 3634 Euclid Ave., Cleveland, Ohio
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1. For precleaning in the plating shop

Oakite precleaners quickly remove the toughest soils that work their way into the plating shop. This 44-page illustrated booklet gives useful information about tank precleaning on pages 6 to 11 and machine precleaning on pages 11 to 14.

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Oakite Rustripper saves time by removing heat scale and rust in the same operation that removes oil. Alkaline pickling with Rustripper avoids hydrogen embrittlement, etching of machined surfaces and other disadvantages of acid pickling.

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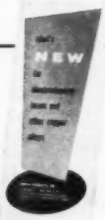
Oakite Composition No. 90 is a reverse-current cleaner with great ability to remove oils, smuts and other objectionable films that interfere with good electroplating. Solutions have high conductivity and long service life. Controlled foaming eliminates explosion hazards.



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Oakite Composition No. 191 scientifically protects brass from the oxygen that tarnishes during the use of reverse current. Solutions have high conductivity, long life and high tolerance for chromic acid carried over by plating racks.

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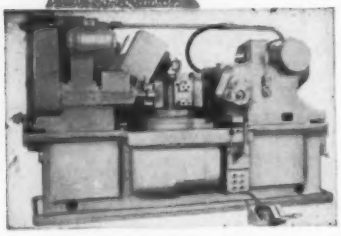

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Japan Bearing Export Co., Ltd., Tokyo, Japan
Marlin-Rockwell Corp., 402 Chandler Bldg., Jamestown, N. Y.
Nice Ball Bearing Co., 30th & Hunting Park Ave., Philadelphia, Pa.
Norma-Hoffmann Bearings Corp., Stamford, Conn.

BEARINGS, Bronze and Special Alloy
Boston Gear Works, 3200 Main St., North Quincy, Mass.
Bunting Brass & Bronze Co., 715 Spencer, Toledo, Ohio

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Bunting Brass & Bronze Co., 715 Spencer, Toledo 1, Ohio
Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

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Ball & Roller Bearing Co., Danbury, Conn.
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Marlin-Rockwell Corp., 402 Chandler Bldg., Jamestown, N. Y.
Norma-Hoffmann Bearings Corp., Stamford, Conn.
Rollway Bearing Co., Inc., 541 Seymour St., Syracuse, N. Y.
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Marlin-Rockwell Corp., 402 Chandler Bldg., Jamestown, N. Y.
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Norma-Hoffmann Bearings Corp., Stamford, Conn.
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BELT SANDERS—See Grinding Machines, Abrasive Belt

BENCH CENTERS
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Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.

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Greenlee Bros. & Co., 2136—12th St., Rockford, Ill.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.

BENDERS, Plate, Etc.
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Chambersburg Engrg. Co., Chambersburg, Pa.
Denison Engineering Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Hydraulic Press Mfg. Co., Mount Gilead Ohio.
Niagara Machine & Tool Works, 683 Northland Ave., Buffalo, N. Y.
Verson Allsteel Press Co., 93rd St. & S. Kenwood Ave., Chicago, Ill.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.

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59-B-1

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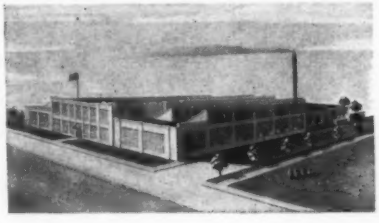

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Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
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Orban Kurt Co., Inc., 42 Exchange Place Jersey City 2, N. J.
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BOOKS, Technical
Industrial Press, 93 Worth St., New York 13, N. Y.

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Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.
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Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
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Kennametal Inc., Latrobe, Penna.
Metallurgical Products Dept. of General Electric Co., Box 327, Roosevelt Park Annex, Detroit 32, Mich.
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Bridgeport Machines, Inc., 500 Lindley St., Bridgeport 6, Conn.
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Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
DeVlieg Microbore Div., 2720 W. Fourteen Mile Road, Royal Oak, Mich.
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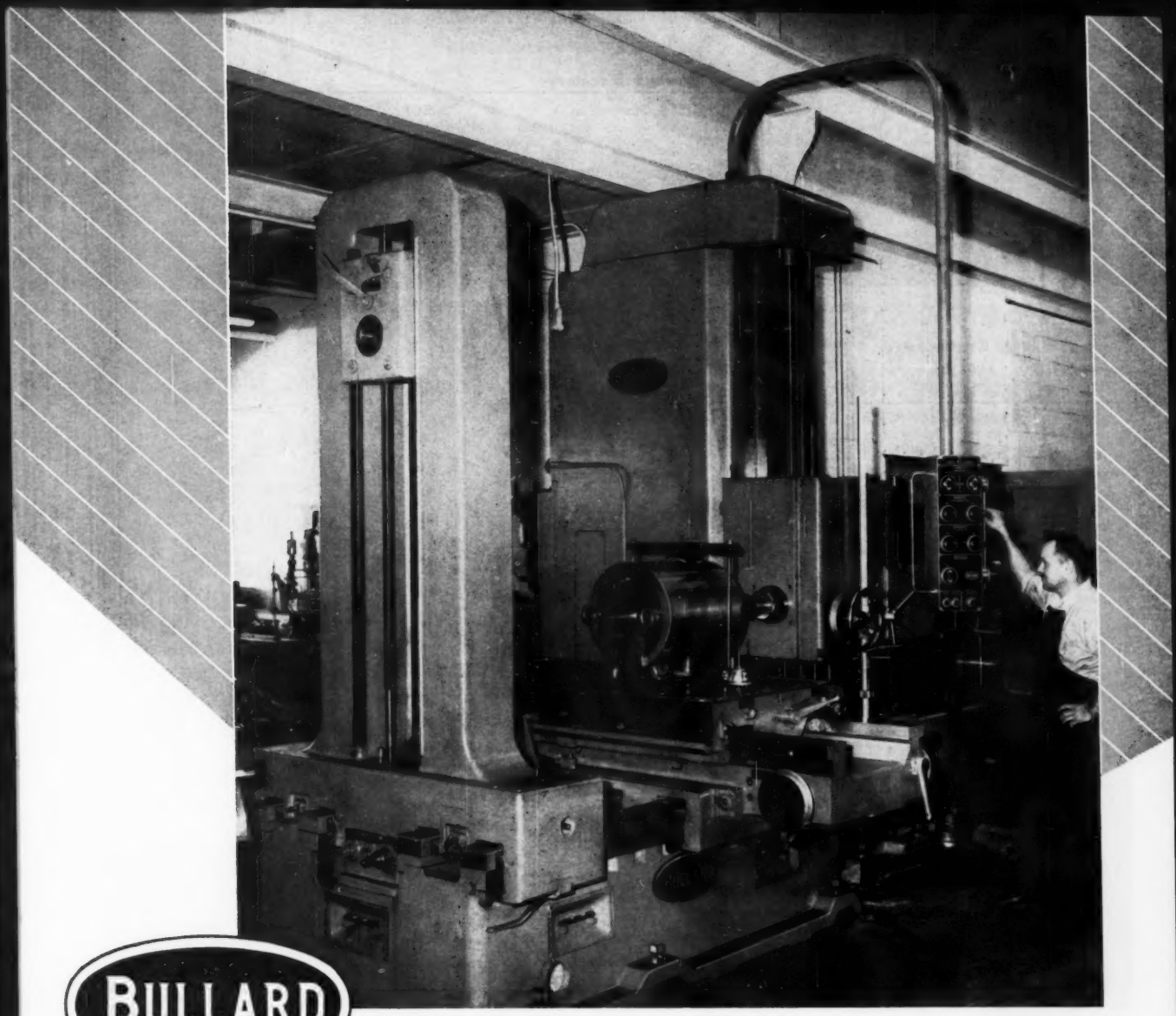
(Continued on page 214)



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"In our business," says Mr. Stanley McDonald,
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Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Moline Tool Co., Moline, Ill
National Automatic Tool Co., Inc., S. 7th and N. Sts., Richmond, Ind.
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
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Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
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Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
DeVlieg Machine Co., Fair St., Royal Oak, Mich.
Espen-Lucas Machine Works, Front St. and Girard Ave., Philadelphia, Pa.
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gray, G. A., Co., 3611 Woodburn Ave., Cincinnati 7, Ohio.
Lucas Mch. Tool Div., New Britain Mch. Co., 12302 Kirby Ave., Cleveland 8, Ohio.
New Britain Mch. Co., New Britain, Conn.
Snyder Corp., 3400 E. Lafayette Ave., Detroit 7, Mich.

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Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Cosa Corp, 405 Lexington Ave., New York 17, N. Y.
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
King Machine Tool Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio.
New Britain Mch. Co., New Britain, Conn.
Snyder Corp., 3400 E. Lafayette Ave., Detroit 7, Mich.

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DeVlieg Microbore Div., 2720 W. Fourteen Mile Road, Royal Oak, Mich.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
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Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.
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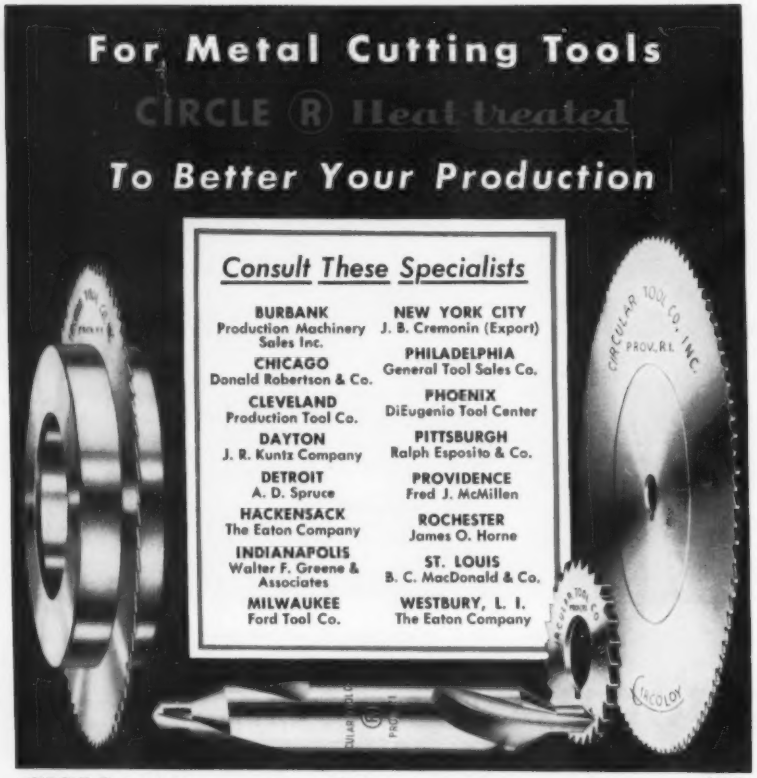

377-8

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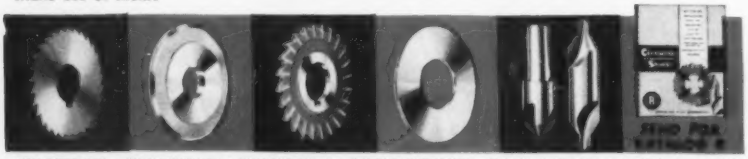
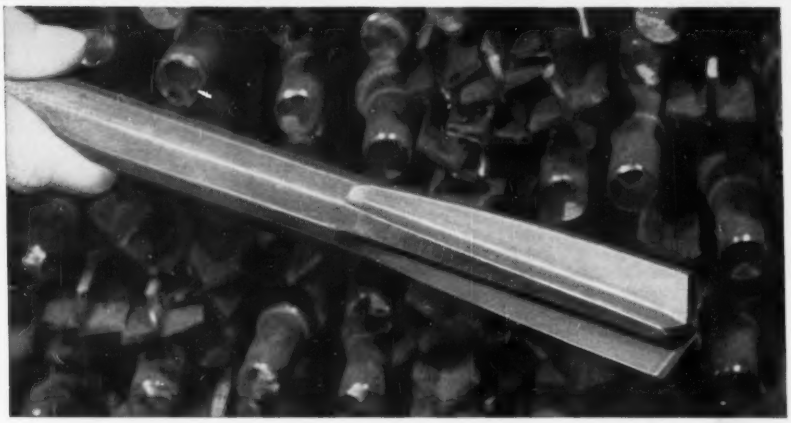


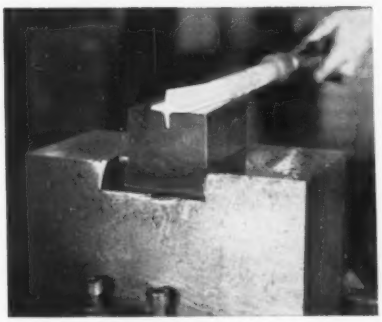
METAL SLITTING SAWS • COPPER SLITTING SAWS • SCREW SLOTTING SAWS • COMMUTATOR SLOTTING SAWS • JEWELERS' SLOTTING SAWS • CUT OFF SAWS • CIRCULAR KNIVES & ROTARY SHEAR BLADES • CIRCOLOY STEEL SAWS • SOLID & TIPPED TUNGSTEN CARBIDE SAWS • COMBINED DRILLS & COUNTERSINKS • CENTER REAMERS

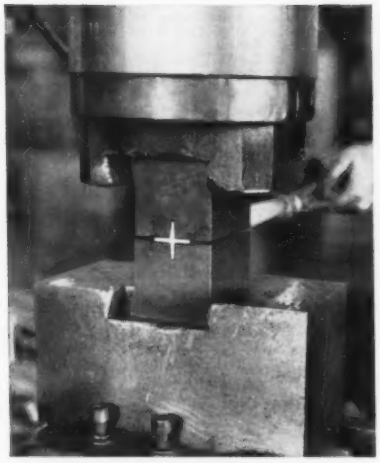
Tool Steel Topics

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.



57 HW tool steel forges star drills while they're red hot





In the Hampstead, Md., plant of Black & Decker Manufacturing Co., they needed a hot-work tool steel for use in the hot forging of star drills. The drills were to be made from 7/8-in. carbon steel. The tool steel for the forging dies had to be easy to machine, have good resistance to wash, and stay on the job for long periods.

Several competitive tool steels were tried, but their major shortcoming was insufficient resistance to wash in critical areas of the die. Then Bethlehem 57 HW was used because of its high tungsten content, which leads to excellent resistance to wash and wear.

After the 57 HW die had been in service for some time, we learned that it had given a good account of itself in this application. The die had been hardened to approximately Rockwell C46. It was extremely economical because of the way it stayed on the job.

Once again a Bethlehem tool steel had provided outstanding service in the field.

57 HW (AISI H-21) is our 9 pct tungsten type of hot-work tool steel. Air-hardened, it has high red-hardness and high abrasion-resistance. It also has good resistance to heat-checking, and can take plenty of shock.

Typical Analysis

Carbon	0.35	Tungsten	9.35
Chromium	3.25	Vanadium	0.50

57 HW has been proved in many hot-work applications. But don't take our word for it. Give it a trial in your shop. You'll find your Bethlehem tool steel distributor at your service.

BETHLEHEM TOOL STEEL ENGINEER SAYS:

Brake Die Steel Can Be Flame Hardened

Brake Die tool steel bars are furnished in the heat-treated condition (squares and flats Brinell 248/293, and rounds 302/352) so that the customer merely has to machine the tool to the dimensions desired. For many types of metal forming operations, Brake Die steel does an excellent job. On some operations, however, certain areas of the dies may wear away faster than others. A common cure for this trouble is to use small inserts of BTR, our standard manganese oil-hardening tool steel, hardened to Rockwell C58-60 at the wear points.

A more economical way to solve this problem is to locally flame-harden the Brake Die steel at the wear points. Small surface areas on tools made of Brake Die steel can be hardened by merely heating with an oxy-acetylene torch for a few seconds (long enough to heat the surface to a definite red color, approximately 1500F). No quenching is required. The portion of the steel which is heated will harden to Rockwell C55-60 because of the rapid cooling produced by the conduction of heat from the small heated spot into the larger adjacent areas which have not been heated.

Flame hardening is not ordinarily considered for hardening tools, but here is the exception which proves the rule.

Why They Go for A-H5

In this shop, they wanted to combine long wear and minimum distortion on various types of trimming and blanking dies. They chose A-H5 (SAE A-2), and it did everything expected of it, and then some. A-H5 is our medium alloy air-hardening grade, with 5 pct chromium. It holds a keen cutting edge, has good resistance to abrasion and wear, and good deep-hardening properties. It's also easy to machine, as indicated above.

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Delta Power Tool Div., 400 Lexington Ave., Pittsburgh 8, Pa.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

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Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.

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Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.

BURRING MACHINES—See Deburring Machines

BURRS—See Files and Burrs, Rotary

BUSHINGS, Drill Jig
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Metal Carbides Corp., 6001 Southern Blvd., Youngstown 12, Ohio.
Universal Engrg. Co., Frankenmuth, Mich.

BUSHINGS, Hardened Steel
Universal Engrg. Co., Frankenmuth, Mich.

BUSHINGS, Non-ferrous and Powdered Metal
Bearings, Inc., 3634 Euclid Ave., Cleveland 15, Ohio.
Bunting Brass & Bronze Co., 715 Spencer, Toledo, Ohio.
Universal Engrg. Co., Frankenmuth, Mich.

CALIPERS, Spring, Firm-Joint, Transfer, Hermaphrodite, etc.—See Layout and Drafting Tools, Machinists' Small Tools

CALIPER, Vernier
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DoALL Co., Des Plaines, Ill.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.
Starrett, The L. S. Co., Athol, Mass.

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Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Russell Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

CAM MILLING AND GRINDING MACHINES
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Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
Cincinnati Milling Machine Co., Oakley, Cincinnati, Ohio.
Landis Tool Co., Waynesboro, Pa.
Rowbottom Machine Co., Waterbury, Conn.

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Eisler Engrg. Co., Inc., 750 S. 13th, Newark 3, N. J.
Hartford Special Machinery Co., 287 Homestead St., Hartford, Conn.
Rowbottom Machine Co., Waterbury, Conn.

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DoAll Co., Des Plaines, Ill.
Linde Co., 30 E. 42nd St., New York 17, N. Y.
Metal Carbides Corp., Youngtown, Ohio.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Vascoloy-Ramet Corp., Waukegan, Ill.

CASTINGS, Die
American Brass Co., Waterbury 20, Conn.
Madison-Kipp Corp., Madison, Wis.

CASTINGS, Non-ferrous
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Mueller Brass Co., Port Huron 35, Mich.
Pittsburgh Brass Mfg. Co., 3199 Penn Ave., Pittsburgh 1, Penna.
Vascoloy-Ramet Corp., Waukegan, Ill.

CASTINGS—Gray Iron, Malleable
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

CASTINGS, Steel, Stainless, etc.
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
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CEMENT, Abrasive Disc
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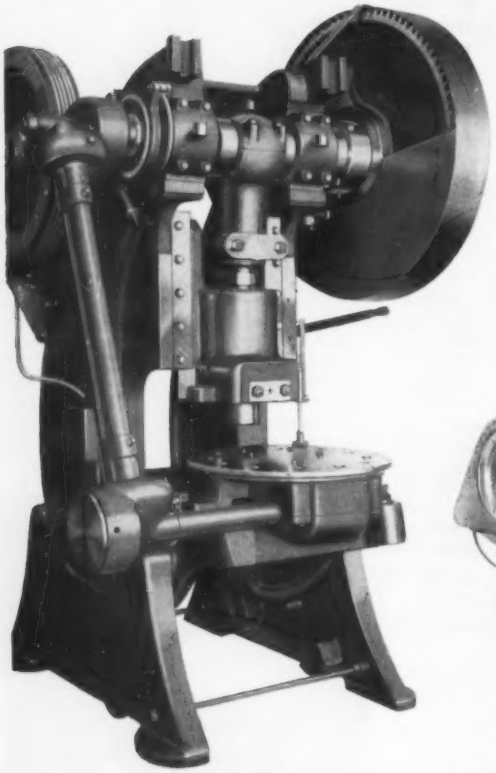
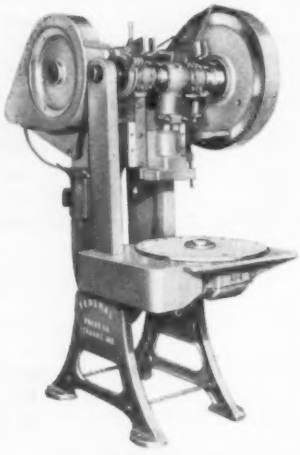


Federal Dial Feeds are your answer to greater production at lower costs. Equipped with special jigging, automatic feeds and ejectors, their applications are virtually unlimited and the need for specialized, more costly equipment often eliminated. (Example, one manufacturer increased production 600%.)

Add Federal's quality features and workmanship . . . and you've got a winner. Investigate Federal Dial Feeds for your operations. Gear or chain driven with cam-type indexing mechanisms. Sizes range from 6 to 80 tons.

No. 7 Dial Feed
Gear Driven. Capacity, 80 tons.



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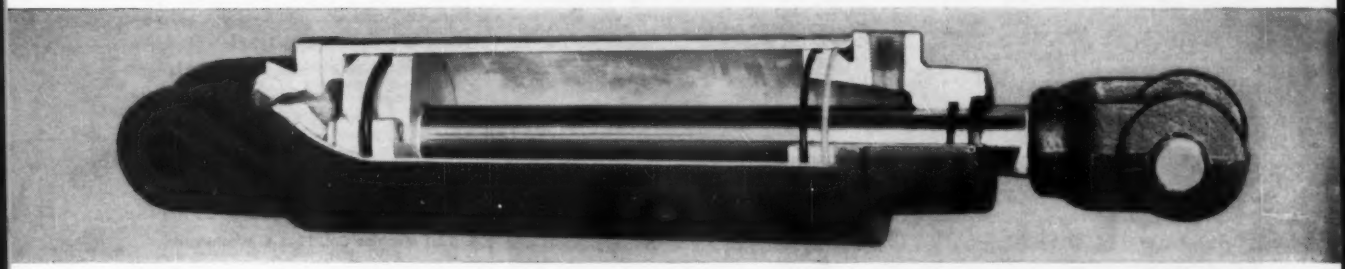
There's a HOLE lot of sense in this use of mechanical tubing

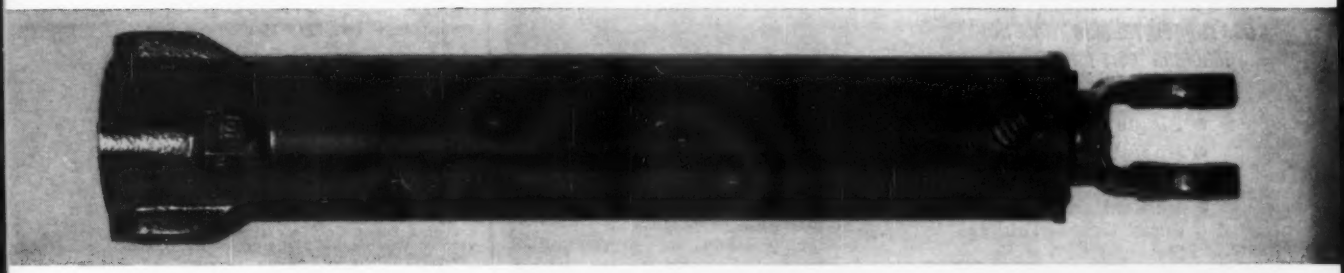
What we're talking about is USS Shelby Seamless Mechanical Tubing. Here's how Industrial Hydraulics Division, Cessna Aircraft Company uses it to boost life, simplify manufacture and lower costs in the hydraulic cylinders they supply to agricultural equipment builders. We quote from their letter to us:

"The cut-away cylinder is a unit we furnish to one of our many customers. This is a 3½" diameter, double-action cylinder used for mounting on pull-behind tools



such as plows, cultivators, and disc harrows. This cylinder uses your Shelby Seamless Mechanical Tubing with the I.D. bored to size and roller burnished to a finish of approximately six to eight RMS. The expected life of this cylinder is in excess of 300,000 cycles, operating at 1,500 psi hydraulic pressure.

"The other cylinder is furnished to another one of our customers, and is a 3¼" I.D. double-action cylinder with a 13" stroke. Used to raise and lower the platform of their self-propelled combine, it is similar to the cut-away cylinder



with respect to finish requirements and material for the barrel. The operating pressure is approximately the same and so is the expected service life of five years, or 300,000 cycles. Generally these cylinders may be serviced for additional use by merely replacing the seals.

"The severe field conditions these cylinders are subjected to are some of the most extreme to which cylinders could be exposed."

In critical mechanical applications like these, and in an almost endless number of fabrications that are essentially tubular in character, Shelby Seamless will ensure improved performance, finer appearance and economical production.

For Shelby Seamless offers more than just a pre-bored hole. It not only combines to an exceptional degree the qualities of strength, uniformity and dimensional accuracy but, in addition, is readily workable and has excellent machining properties. If you want to find out how it can be most effectively applied to your designs, contact your nearby Shelby Distributor.

And remember—USS Shelby Tubing is made by the world's largest and most experienced manufacturer of tubular products.

USS and Shelby are registered trademarks

National Tube Division of USS **United States Steel**

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Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio.
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.

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Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.

BURRING MACHINES—See Deburring Machines

BURRS—See Files and Burrs, Rotary

BUSHINGS, Drill Jig
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Metal Carbides Corp., 6001 Southern Blvd., Youngstown 12, Ohio.
Universal Engrg. Co., Frankenmuth, Mich.

BUSHINGS, Hardened Steel
Universal Engrg. Co., Frankenmuth, Mich.

BUSHINGS, Non-ferrous and Powdered Metal
Bearings, Inc., 3634 Euclid Ave., Cleveland 15, Ohio.
Bunting Brass & Bronze Co., 715 Spencer, Toledo, Ohio.
Universal Engrg. Co., Frankenmuth, Mich.

CALIPERS, Spring, Firm-Joint, Transfer, Hermaphrodite, etc.—See Layout and Drafting Tools, Machinists' Small Tools

CALIPER, Vernier
Brown & Sharpe Mfg. Co., Providence, R. I.
DoALL Co., Des Plaines, Ill.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.
Starrett, The L. S. Co., Athol, Mass.

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Cincinnati Milling & Grinding Mchs., Inc., Cincinnati 9, Ohio.
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Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Russell Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

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Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
Cincinnati Milling Machine Co., Oakley, Cincinnati, Ohio.
Landis Tool Co., Waynesboro, Pa.
Rowbottom Machine Co., Waterbury, Conn.

CAMS
Brown & Sharpe Mfg. Co., Providence, R. I.
Eisler Engrg. Co., Inc., 750 S. 13th, Newark 3, N. J.
Hartford Special Machinery Co., 287 Homestead St., Hartford, Conn.
Rowbottom Machine Co., Waterbury, Conn.

CARBIDES
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
DoAll Co., Des Plaines, Ill.
Linde Co., 30 E. 42nd St., New York 17, N. Y.
Metal Carbides Corp., Youngtown, Ohio.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Vascoloy-Ramet Corp., Waukegan, Ill.

CASTINGS, Die
American Brass Co., Waterbury 20, Conn.
Madison-Kipp Corp., Madison, Wis.

CASTINGS, Non-ferrous
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Mueller Brass Co., Port Huron 35, Mich.
Pittsburgh Brass Mfg. Co., 3199 Penn Ave., Pittsburgh 1, Penna.
Vascoloy-Ramet Corp., Waukegan, Ill.

CASTINGS—Gray Iron, Malleable
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

CASTINGS, Steel, Stainless, etc.
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Birdsboro Steel Fdry. & Mch. Co., Birdsboro, Pa.

CEMENT, Abrasive Disc
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.

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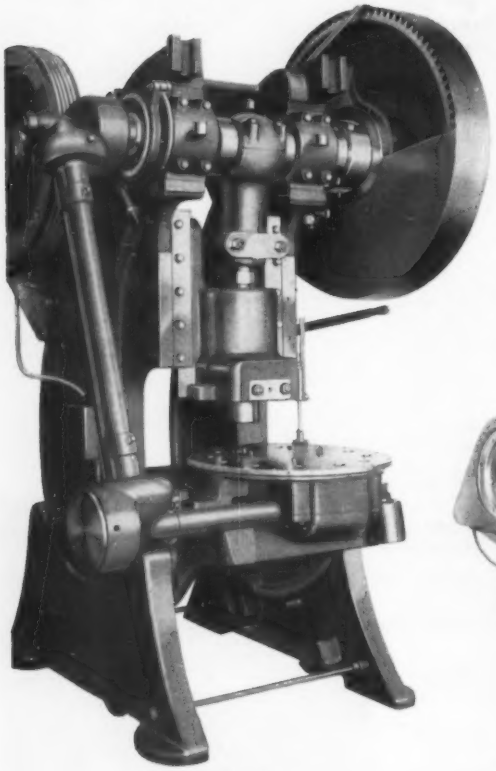

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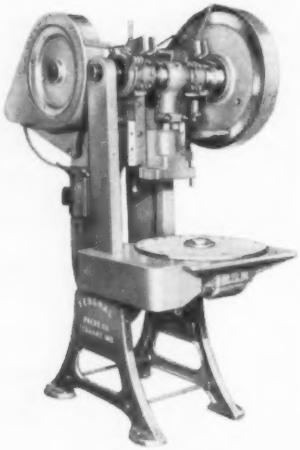

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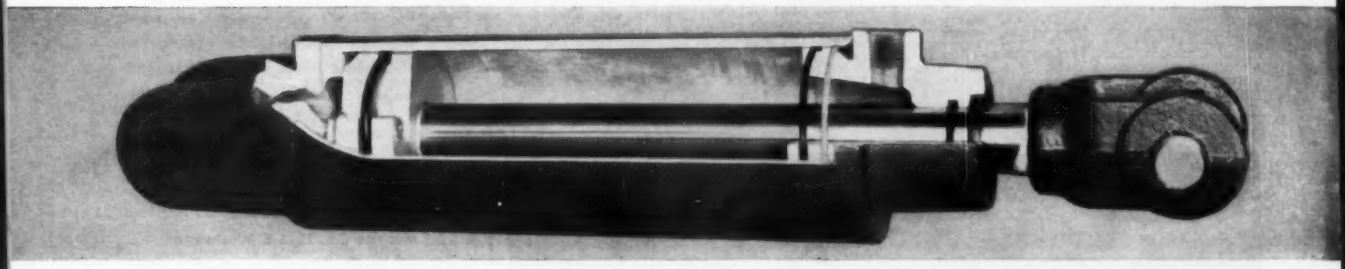
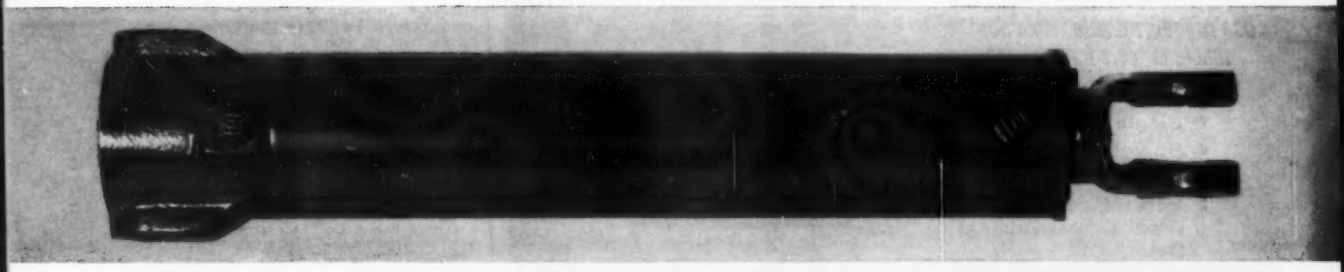


such as plows, cultivators, and disc harrows. This cylinder uses your Shelby Seamless Mechanical Tubing with the I.D. bored to size and roller burnished to a finish of approximately six to eight RMS. The expected life of this cylinder is in excess of 300,000 cycles, operating at 1,500 psi hydraulic pressure.

"The other cylinder is furnished to another one of our customers, and is a 3¼" I.D. double-action cylinder with a 13" stroke. Used to raise and lower the platform of their self-propelled combine, it is similar to the cut-away cylinder



with respect to finish requirements and material for the barrel. The operating pressure is approximately the same and so is the expected service life of five years, or 300,000 cycles. Generally these cylinders may be serviced for additional use by merely replacing the seals.

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And remember—USS Shelby Tubing is made by the world's largest and most experienced manufacturer of tubular products.

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United States Steel Supply Division • United States Steel Export Company, New York

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Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

CENTER PUNCHES—See Machinists' Small Tools

CENTERS, Grinding Machines, Indexing Head and Lathe
Bearings, Inc., 3634 Euclid Ave., Cleveland 15, Ohio.
Houston Grinding & Mfg. Co., Inc., Houston 8, Texas.
Metal Carbides Corp., Youngstown, Ohio.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit, Mich.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

CERAMIC TOOL MATERIAL—See Tool Material, Ceramic

CHAINS, Power Transmission and Conveyor
Boston Gear Works, 14 Hayward St., Quincy 71, Mass.

CHUCKING MACHINES, Multiple-Spindle Automatic
Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.
Cross Co., 3250 Bellevue Ave., Detroit 7, Mich.
Goss & DeLeeuw Mch. Co., Kensington, Conn.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
Olofsson Corp., 2729 Lyons Ave., Lansing, Mich.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio.

CHUCKING MACHINES, Single-Spindle Automatic
Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.
Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Jones & Lamson Mch. Co., Springfield, Vt.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
Potter & Johnston Co., 1027 Newport Ave., Pawtucket, R. I.
Russell Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 83, Ohio.

CHUCKS, Air Operated
Cushman Chuck Co., Windsor Ave., Hartford, 2, Conn.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Logansport Machine Co., Inc., 810 Center Ave., Logansport, Ind.
Schrader's Son, A., 470 Vanderbilt Avenue, Brooklyn, N. Y.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Collet
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio.
Cushman Chuck Co., 800 Windsor St., Hartford 2, Conn.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Gisholt Mch. Co., 1245 E. Washington Ave., Madison 10, Wis.
Gorton Mch. Co., Geo., 1321 Racine St., Racine, Wis.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Jacobs Mfg. Co., West Hartford 10, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio.
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio.
Universal Engrg. Co., Frankenmuth 2, Mich.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio.

CHUCKS, Combination Universal-Independent
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Compensating
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Diaphragm
Woodworth, N. A. Co., 1300 E. Nine Mile Rd., Detroit 20, Mich.

CHUCKS, Drill, Key Type
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Jacobs Mfg. Co., West Hartford, Conn.

CHUCKS, Drill, Keyless
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Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Jacobs Mfg. Co., West Hartford, Conn.

CHUCKS, Full Floating
Gisholt Mch. Co., Madison 10, Wis.
Scully-Jones & Co., 1903 Rockwell St., Chicago 8, Ill.
Universal Engineering Co., Frankenmuth 2, Mich.

CHUCKS, Gear
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Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Le Maire Tool & Mfg. Co., Dearborn, Mich.
Supreme Products, Inc., 2222 S. Calumet Ave., Chicago 16, Ill.

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Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Lathes, etc.
Bullard Co., Brewster St., Bridgeport 2, Conn.
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Horton Chuck, Windsor Locks, Conn.
Jacobs Mfg. Co., West Hartford, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio.

CHUCKS, Magnetic
Brown & Sharpe Mfg. Co., Providence, R. I.
DoAll Co., 254 Laurel Ave., Des Plaines, Ill.
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Walker, O. S. Inc., Worcester, Mass.

CHUCKS, Power Operated
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Gisholt Mch. Co., Madison 10, Wis.
Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Quick Change and Safety
Jacobs Mfg. Co., West Hartford 10, Conn.
Universal Engineering Co., Frankenmuth 2, Mich.

CHUCKS, Ring Wheel
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Gardner Mch. Co., 414 E. Gardner St., Beloit, Wis.

CHUCKS, Tapping
DoALL Co., 254 N. Laurel Ave., Des Plaines, Ill.
Errington Mechanical Laboratory, 24 Norwood Ave., Stapleton, Staten Island, N. Y.
Jacobs Mfg. Co., West Hartford, Conn.
Scully-Jones & Co., 1903 Rockwell St., Chicago 8, Ill.

CHUCKS, Universal Three-Jaw
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Gisholt Mch. Co., Madison 10, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio.

CHUCKS, Wrenchless
Gisholt Mch. Co., Madison 10, Wis.

CLAMPS, "C", Toggle, Toolmakers' Parallel—See Set-Up Equipment

CLEANERS, Metal
Oakite Products, Inc., 26 Rector St., New York, N. Y.

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Conway Clutch Co., 2747 Colerain Ave., Cincinnati 25, Ohio.
Dynamatic Div. Eaton Mfg. Co., Kenosha, Wis.
Minster Mch. Co., Minster, Ohio.

COLD HEADING
National Machinery Co., Tiffin, Ohio.
Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.

COLLETS—See Chucks, Collet

COMBINATION SQUARES—See Machinists' Small Tools

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Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Sheffield Corp., Box 883, Dayton 1, Ohio.
Starrett, L. S., Co., Athol, Mass.

COMPARATORS, Optical
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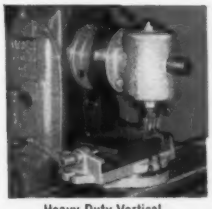
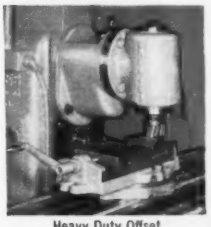
DoALL Co., 254 N. Laurel Ave., Des Plaines, Ill.
Eastman Kodak Co., Rochester, N. Y.
Jones & Lamson Mch. Co., Springfield, Vt.
Opto-Metric Tools, Inc., 137 Varick St., New York 13, N. Y.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.


Heavy Duty Vertical Milling Attachment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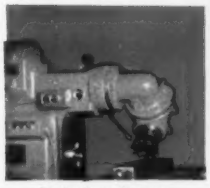
Universal Milling Attachment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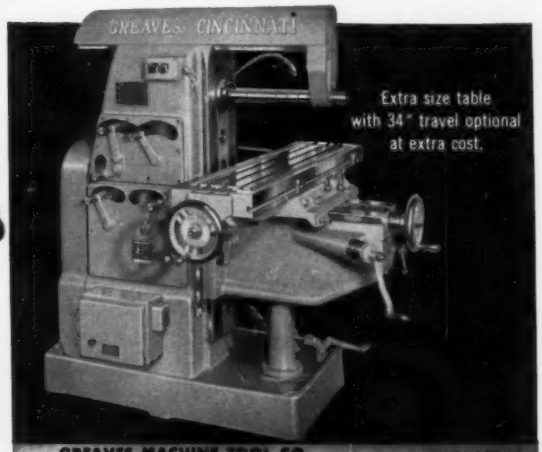

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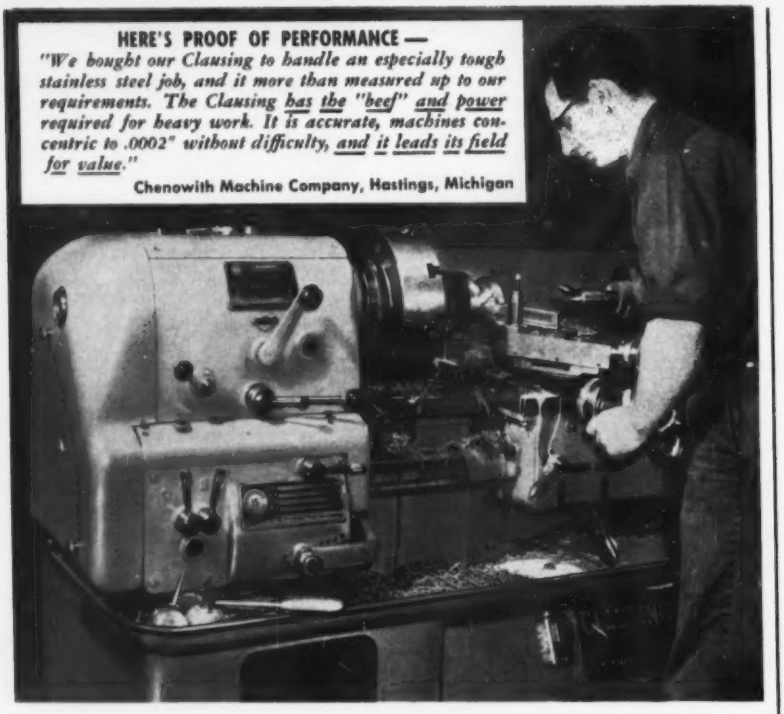

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Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

CONTOUR FOLLOWER—See Tracing Attachments

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Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio.
Eisler Engrg. Co., 750 S. 13th St., Newark 3, N. J.
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Hartford Special Machinery Co., 287 Homestead St., Hartford, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.

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Mueller Brass Co., Port Huron 35, Mich.
Revere Copper & Brass Inc., 230 Park Ave. New York, N. Y.

COUNTERBORES AND COUNTERSINKS
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Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland, Ohio.
DoALL Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
National Tool Co., 11200 Madison Ave., Cleveland 2, Ohio.
National Twist Drill & Tool Co., Rochester, Mich.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio.
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.

COUNTERS
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Boston Gear Works, 14 Hayward St., Quincy 71, Mass.
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Schrader's Sons, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.
Walker Co., Inc., O. S., Rockdale St., Worcester, Mass.

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Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y.

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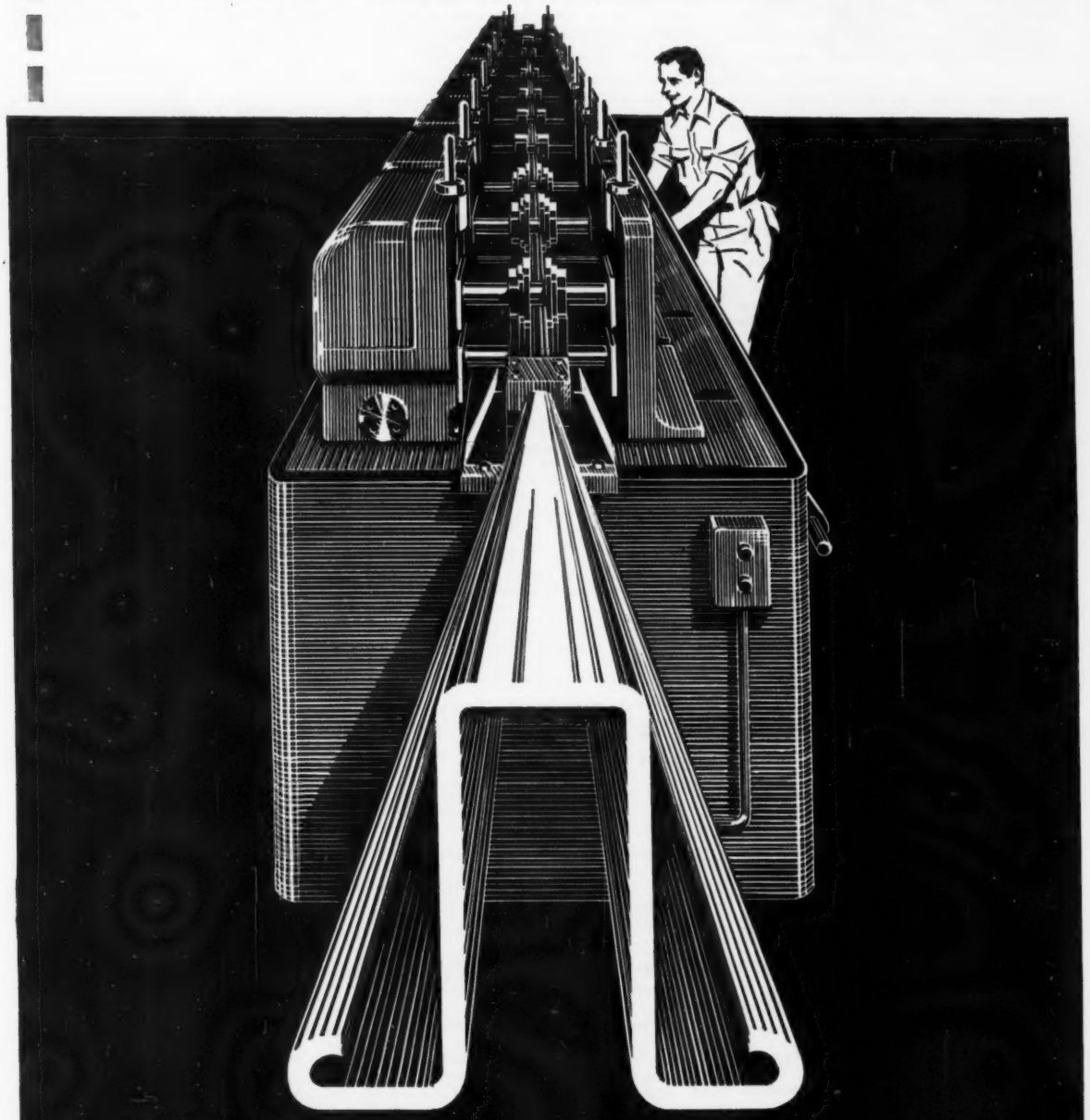

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DoALL Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Gorton, George, Mch. Co., 1321 Racine St., Racine, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
National Tool Co., 11200 Madison Ave., Cleveland 2, Ohio.
National Twist Drill Co., Rochester, Mich.
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Tomkins-Johnson Co., Jackson, Mich.
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DoALL Co., Des Plaines, Ill.
Oakite Products, Inc., 26 Rector St., New York 6, N. Y.
Shell Oil Co., 50 W. 50th St., New York, N. Y.
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Texas Co., 135 E. 42nd St., New York, N. Y.

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Modern Machine Tool Co., Jackson, Mich.

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Norton Co., 1 New Bond St., Worcester 6, Mass.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.

CUTTING TOOLS—See Tool Material

CYLINDERS, Air

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Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.
Tomkins-Johnson Co., Jackson, Mich.

CYLINDERS, Hydraulic

Barnes, John S., Corp., 301 S. Water St., Rockford, Ill.
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Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.
Logansport Machine Co., Inc., Logansport, Ind.
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Vickers, Inc., Detroit 32, Mich.

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Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland 14, Ohio.
Sheffield Corp., Box 893, Dayton 1, Ohio.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.

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Hydraulic Press Mfg. Co., Mount Gilead, Ohio.

DIE CUSHIONS

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Clearing Mch. Corp., 6499 W. 65th St., Chicago, Ill.
Danly Machine Specialties, Inc., 2100 South Laramie, Chicago 50, Ill.
Federal Machine & Welder Co., Overland Ave., Warren, Ohio.
Minster Machine Co., Minster, Ohio.
Verson Allsteel Press Co., 93rd St., and S. Kenwood Ave., Chicago, Ill.

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Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Vascoloy-Ramet Corp., Waukegan, Ill.

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DIE SINKING MACHINES—See Milling Machines, Die Sinking, etc.

DIE STOCKS—See Stocks and Dies

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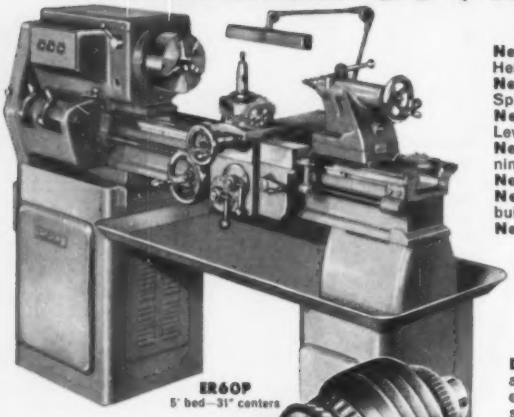

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New. 1¼" Hole through Spindle.
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New. Amazing LOW PRICE.

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Different. Spindle rigidly held in two large "Zero Precision tapered roller bearings arranged in box-type design.
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Different. Triple, cogged, V-belt outboard drive—eliminates intermediate shafts—delivers more power to spindle.

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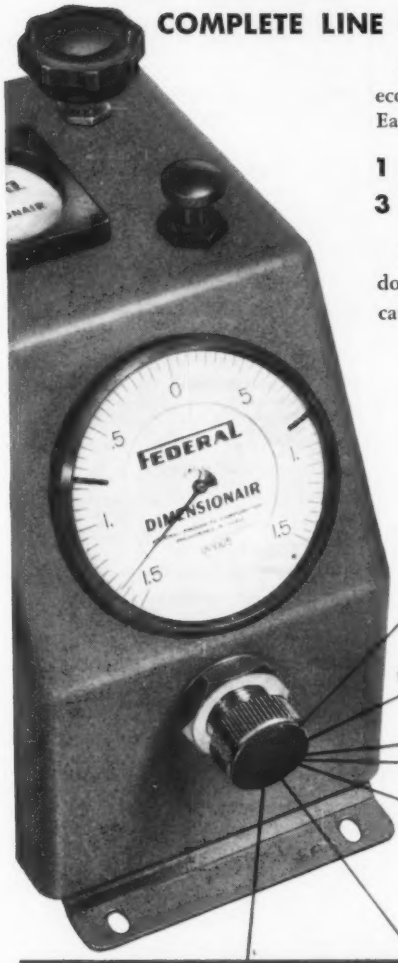

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Regularly furnished with two or three jets. Can also be furnished with one, four, or six jets. Jets are larger and recessed farther below surface than in competitive makes. This helps eliminate clogging and reduces wear. Inside diameters from .250" up to and including 3.010". Smaller and larger sizes on application.

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Links the Federal Dimensionair to your Arnold Grinding Gage to provide closer operator control than is possible using a Dial Indicator alone. The Arnoldair response smooths out surface irregularities, allowing the operator to consistently grind pieces within .0001" of nominal. Easily attached to any Arnold Gage. Catalog 55A.

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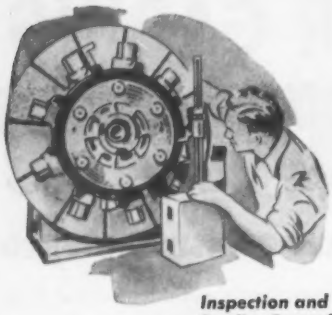
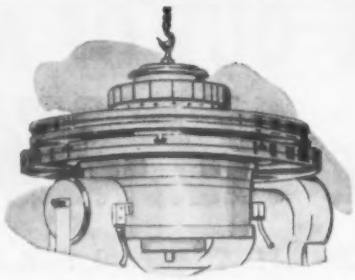
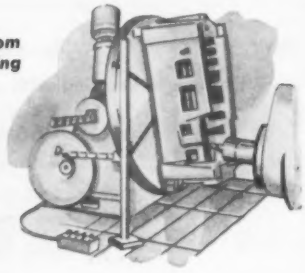


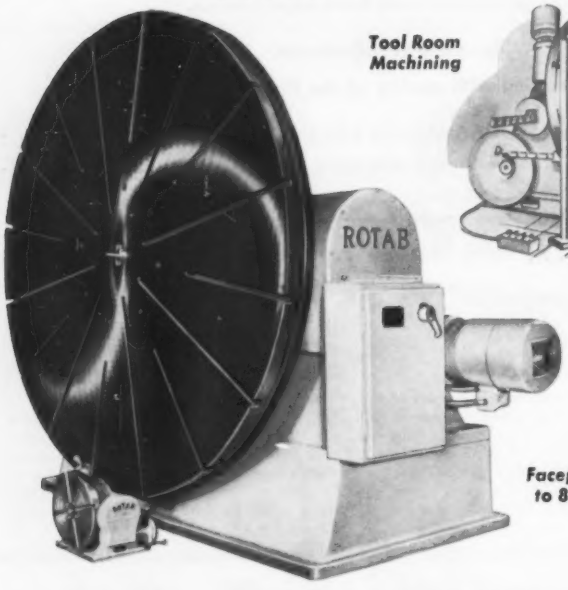
Inspection and Quality Control



Experimental and Tool Room Layout

Tool Room Machining





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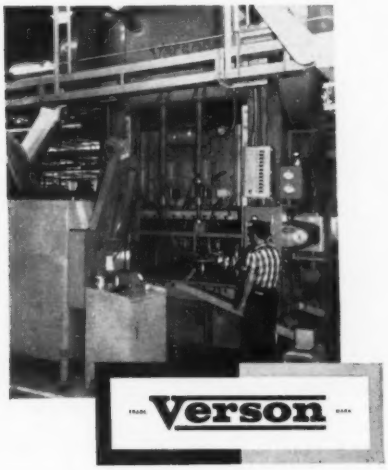

If you manufacture machined parts by cutting away sections of a chunk of steel until only a piece of the required size and shape remains, you may be missing an opportunity to substantially reduce your manufacturing costs.

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Snyder Corp., 3400 E. Lafayette Ave., Detroit 7, Mich.
Thriftmaster Products Corp., 1076 N. Plum St., Lancaster, Pa.
United States Drill Head Co., 616 Burns, Cincinnati, Ohio.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio.

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Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
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DoAll Co., Des Plaines, Ill.
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DRILLING ATTACHMENTS, Multiple Spindle—See Drill Heads, Multiple Spindle, and Vises, Machine

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Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
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Russell Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
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Townsend, H. P. Mfg. Co., Elmwood, Conn.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio.

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Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
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Edlund Mchry. Co., Div., Cortland, N. Y.
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Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
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Kingsbury Mch. Tool Corp., Keene, N. H.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Leland-Gifford Co., Box 989, Worcester 1, Mass.
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National Automatic Tool Co., Inc., S. 7th and N. Sts., Richmond, Ind.
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Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Snow Manufacturing Co., Bellwood, Ill.
Wales-Strippit Corp., Akron, N. Y.
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DRILLING MACHINES, Bench

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Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Cincinnati Lathe & Tool Co., 3207 Disney St., Cincinnati 9, Ohio
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh, Pa.
Edlund Machinery Co. Div., Cortland, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio.
Hamilton Tool Co., 834 9th St., Hamilton, Ohio.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Leland-Gifford Co., Box 989, Worcester, Mass.

DRILLING MACHINES, Deep Hole

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
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Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
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National Automatic Tool Co., Inc., S. 7th and N. Sts., Richmond, Ind.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Wales-Strippit Corp., Akron, N. Y.

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Cincinnati Bickford Div., Oakley, Cincinnati, Ohio.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Davis & Thompson Co., 4460 124th St., Milwaukee 10, Wis.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh, Pa.
Edlund Machinery Co., Div., Cortland, N. Y.
Foote-Burt Co., 1300 St. Clair Ave., Cleveland, Ohio.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio.
Greenlee Bros. & Co., 136 12th St., Rockford, Ill.
Hamilton Tool Co., 834 So. 9th St., Hamilton, Ohio.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Leland-Gifford Co., Box 989, Worcester, Mass.
Le Maire Tool & Mfg. Co., Dearborn, Mich.
Moline Tool Co., Moline, Ill.
National Automatic Tool Co., Inc., S. 7th and N. Sts., Richmond, Ind.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio.

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Cincinnati Gilbert Machine Tool Co., 3366 Beekman St., Cincinnati 23, Ohio.
Cincinnati Lathe & Tool Co., 3207 Disney St., Cincinnati 9, Ohio
Cleveland Punch & Shear Works Co., 3917 St. Clair Ave., Cleveland 14, Ohio.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Foote-Burt Co., 1300 St. Clair Ave., Cleveland, Ohio.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio.
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Cincinnati Bickford Div., Oakley, Cincinnati, Ohio.
Cincinnati Lathe & Tool Co., 3207-3211 Disney St., Cincinnati 9, Ohio.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh, Pa.
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Foote-Burt Co., 1300 St. Clair Ave., Cleveland 8, Ohio.
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Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio.
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National Automatic Tool Co., Inc., S. 7th and N. Sts., Richmond, Ind.
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Wales-Strippit Corp., Akron, N. Y.

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DRILLS, Center

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Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio.
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.

DRILLS, Core

Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.
DoAll Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
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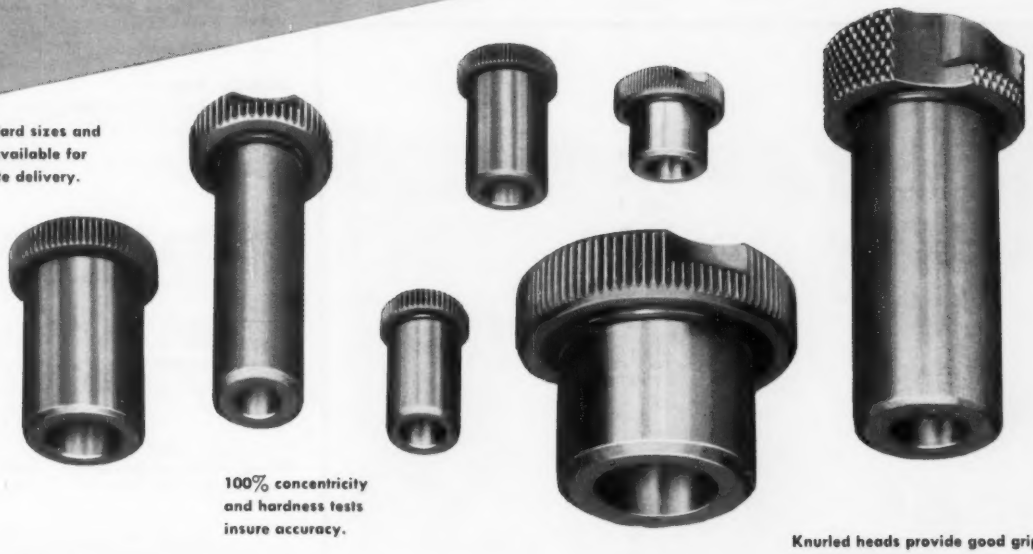
industry's standard of quality and service

All standard sizes and lengths available for immediate delivery.

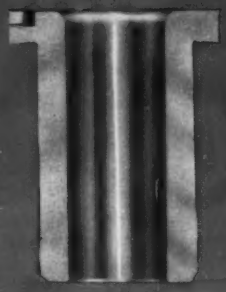


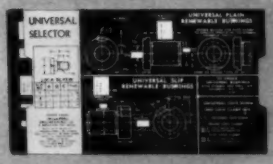
100% concentricity and hardness tests insure accuracy.

Knurled heads provide good grip.

Write for free catalog describing Standard Drill Bushings, Standard Collet Chucks, Floating Collet Chucks, Boring Chucks, Kwik-Switch Tool Holders, Mikro-Lok Boring Bars, Index Plungers and other Universal Products.

Superfinishing of Universal Drill Bushings is an important factor in keeping tool and bushing wear to a minimum . . . especially in close tolerance work. Blended radius helps prevent tool hang-up.





The Universal Drill Bushing Slide Chart gives accurate engineering data for the selection of all types and sizes of drill jig bushings up to 1¾" drill size. Request your calculator—free—on your company letterhead.

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National Twist Drill & Tl. Co., Rochester, Mich.

DRILLS, Oil Hole, Oil Tube
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.
DoAll Co., Des Plaines, Ill.
National Twist Drill & Tl. Co., Rochester, Mich.

DRILLS, Portable Electric
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DRILLS, Portable pneumatic
Chicago Pneumatic Tool Co., New York 17, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

DRILLS, Ratchet
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.
National Twist Drill & Tl. Co., Rochester, Mich.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio.

DRILLS, Subland
Cleveland Twist Drill Co., 1242 49th St., Cleveland 14, Ohio.
DoAll Co., Des Plaines, Ill.
National Twist Drill & Tl. Co., Rochester, Mich.

DRILLS, Twist, High-Speed Steel, Carbon Steel
Cleveland Twist Drill Co., 1242 49th St., Cleveland 14, Ohio.
DoAll Co., Des Plaines, Ill.
National Twist Drill & Tool Co., Rochester, Mich.
Threadwell Tap & Die Co., 16 Arch, Greenfield, Mass.

DRILLS, Twist, Carbide, Carbide-Tipped
Allegheny Ludlum Steel Corp., Oliver Bldg., Pittsburgh 22, Pa.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.
DoAll Co., Des Plaines, Ill.
National Twist Drill & Tool Co., Rochester, Mich.
Threadwell Tap & Die Co., 16 Arch, Greenfield, Mass.

DRILLS, Wire
Cleveland Twist Drill Co., Cleveland, Ohio.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tool Co., Rochester, Mich.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio.

DUPLICATING ATTACHMENTS—See Tracing Attachments

DUST COLLECTORS AND CONTROL SYSTEMS
Brown & Sharpe Mfg. Co., Providence, R. I.
Pangborn Corp., Hagerstown, Md.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 14, Ohio.

ELECTRICAL DISCHARGE MACHINES
—See Distintegrators

ELECTRONIC CONTROL SYSTEMS
Electronic Control Systems, 2231 S. Barrington Ave., Los Angeles 64, Calif.

ENGRAVING MACHINES
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gorton, Geo., Mach., 1321 Racine St., Racine, Wis.

EXTRACTORS, Screw
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.

FACING HEADS
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Davis Boring Tool Div., Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
Mummert-Dixon Co., Hanover, Pa.

FANS, Exhaust, Ventilating
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.

FASTENERS
Allen Mfg. Co., Bloomfield, Conn.
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Russell Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.

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FEEDERS, Automatic
Gear-O-Mation Div., Michigan Tool Co., 7171 McNichols Rd., Detroit 12, Mich.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
V & O Press Co., Hudson, New York

FILES, Band
DoAll Co., Des Plaines, Ill.

FILES, General-purpose, Swiss Pattern
DoAll Co., Des Plaines, Ill.
Simonds Saw & Steel Co., 470 Main St., Fitchburg, Mass.

FILES AND BURRS, Rotary
DoAll Co., Des Plaines, Ill.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Simonds Saw & Steel Co., 470 Main St., Fitchburg, Mass.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

FILING MACHINES
Chicago Pneumatic Tool Co., New York 17, N. Y.
DoAll Co., Des Plaines, Ill.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.

FILTERS, Coolant and Oil
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Marvel Engineering Co., 7227 N. Hamlin Ave., Chicago 45, Ill.

FLAME-HARDENING MACHINES
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Gleason Works, 1000 University Ave., Rochester 3, N. Y.

FORGING HAMMERS, Steam and Air
Chambersburg Engrg. Co., Chambersburg, Pa.
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.

FORGING MACHINES, Headers, Upsetters, Presses
Ajax Mfg. Co., 1441 Chardon Rd., Cleveland 17, Ohio
Bliss, E. W. Co., 1375 Raff Rd. S. W. Canton, Ohio
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
National Machinery Co., Tiffin, Ohio
Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.

FORGING, Hollow-Bored
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Mueller Brass Co., Port Huron 35, Mich.

FORGINGS, Drop
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Mueller Brass Co., Port Huron 35, Mich.
Wyman-Gordon Co., Worcester, Mass.

FORGINGS, Press
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Cleveland Punch & Shear Works Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Minster Mch. Co., Minster, Ohio
Mueller Brass Co., Port Huron 35, Mich.
Revere Copper & Brass Inc., 230 Park Ave., New York 17, N. Y. (die-pressed)

FORGINGS, Upset
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.

FORMING MACHINES, Cold-Rolling
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
Niagara Mch. & Tool Works, 637 Northland Ave., Buffalo, N. Y.
Yoder Co., 5500 Walworth, Cleveland, Ohio

FORMING MACHINES, Multiple-slide
Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Brown & Sharpe Mfg. Co., Providence, R. I.
Chambersburg Engrg. Co., Chambersburg, Pa.
Clearing Machine Corp., 6499 W. 65 St., Chicago 38, Ill.
U. S. Tool Co., Inc., 255 North Main St., Ampere, E. Orange, N. J.

FORMING TOOLS or Tool Blanks
Brown & Sharpe Mfg. Co., Providence, R. I.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

GAGE BLOCKS
Brown & Sharpe Mfg. Co., Providence, R. I.
DoALL Co., 254 N. Laurel Ave., Des Plaines, Ill.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

GAGES, Air Comparator
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio

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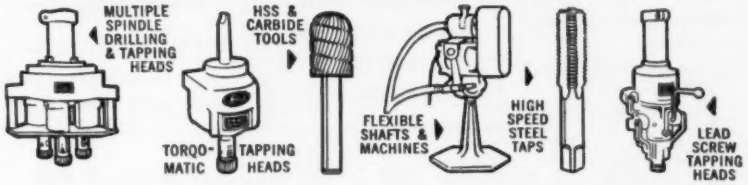

JARVIS CORPORATION • MIDDLETOWN, CONNECTICUT

For more data, circle this page number on inquiry card

GAGES, Automatic Sorting

Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Sheffield Corp., Box 893, Dayton 1, Ohio

GAGES, DIAL, Bore, Height, Depth, Thread, Groove, etc.

Ames, B. C., Co., Waltham 54, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
DoALL Co., 254 N. Laurel Ave., Des Plaines, Ill.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Starrett, The L. S., Co., Athol, Mass.

GAGES, Electric Comparator

Brown & Sharpe Mfg. Co., Providence, R. I.
DoALL Co., 254 N. Laurel Ave., Des Plaines, Ill.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Sheffield Corp., Box 893, Dayton 1, Ohio

GAGES, Grinding

Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Sheffield Corp., Box 893, Dayton 1, Ohio

GAGES, Machinists' Hand, including Center, Cutter Clearance, Drill Point, Drill Size, Planer, Radius, Screw Pitch, Taper Telescoping Thickness

Brown & Sharpe Mfg. Co., Providence, R. I.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.

GAGES, Multiple Inspection

Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Sheffield Corp., Box 893, Dayton 1, Ohio

GAGES, Plug and Ring

Brown & Sharpe Mfg. Co., Providence, R. I.
DoALL Co., 254 N. Laurel Ave., Des Plaines, Ill.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio
Threadwell Tap & Die Co., 16 Arch, Greenfield, Mass.
Winter Bros. Co., Rochester, Mich.

GAGES, Roll Thread Snap, Adjustable Snap

Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Sheffield Corp., Box 893, Dayton 1, Ohio
Threadwell Tap & Die Co., 16 Arch, Greenfield, Mass.

GAGES, Surface Roughness

DoAll Co., Des Plaines, Ill.
Sheffield Corp., Box 893, Dayton 1, Ohio

GAGES, VERNIER, Height, Depth, Gear Tooth

Brown & Sharpe Mfg. Co., Providence, R. I.
DoALL Co., Des Plaines, Ill.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Starrett, The L. S., Co., Athol, Mass.

GEAR BURNISHERS

Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio

GEAR CHAMFERING, ROUNDING AND DEBURRING MACHINES

Bilgram Gear & Mch. Works, 1217-35 Spring Garden St., Philadelphia, Pa.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Cross Co., 3250 Bellevue Ave., Detroit 7, Mich.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheffield Corp., Box 893, Dayton 1, Ohio

GEAR CHECKING EQUIPMENT

Brown & Sharpe Mfg. Co., Providence, R. I.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

GEAR CUTTING MACHINES, Bevel and Spiral

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

GEAR CUTTING MACHINES, Worm and Worm Wheels

Barber-Colman Co., 1300 Rock St., Rockford, Ill.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.

(Continued on page 232)

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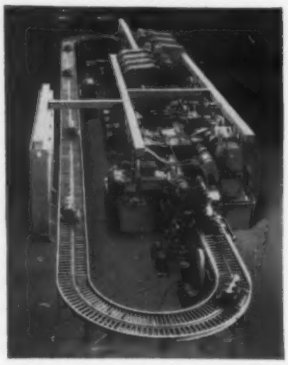

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Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

GEAR GRINDERS—See Grinding Machines, Gear

GEAR HOBBERS

American Schiess Corp., 1232 Penn. Ave., Pittsburgh 22, Pa.
Barber-Colman Co., 1300 Rock St., Rockford, Ill.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Fellows Gear Shaper Co., Springfield, Vt.
Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.

GEAR HONERS

National Broach & Mch. Co., 5600 St. Jean, Detroit 13, Mich.

GEAR LAPPERS

Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
National Broach & Mch. Co., 5600 St. Jean, Detroit 12, Mich.

GEAR MOTORS—See Speed Reducers

GEAR RACKS

Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Stahl Gear & Mch. Co., The, 3901 Hamilton Ave., Cleveland 4, Ohio

GEAR SHAPERS

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Fellows Gear Shaper Co., Springfield, Vt.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.

GEAR SHAVERS

Fellows Gear Shaper Co., Springfield, Vt.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.

GEARS, AND GEAR BLANKS, Nonmetallic

Boston Gear Works, 14 Hayward St., Quincy 71, Mass.
Cincinnati Gear Co., Wooster Pike and Mariemont Ave., Cincinnati, Ohio
Diefendorf Gear Corp., Box 934, Syracuse, N. Y.
Greaves Machine Tool Co., 2011 Eastern Ave., Cincinnati, Ohio
New Jersey Gear & Mfg. Co., Hillside, N. J.
Ryerson, Jos. T. & Son, Inc., 16th and Rockwell St., Chicago 8, Ill.
Stahl Gear & Mch. Co., 3901 Hamilton Ave., Cleveland 14, Ohio

GEARS, Cut

Bilgram Gear & Mch. Works, 1217-35 Spring Garden St., Philadelphia, Pa.
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Boston Gear Works, 14 Hayward St., Quincy 71, Mass.
Cincinnati Gear Co., Wooster Pike and Mariemont Ave., Cincinnati, Ohio
Diefendorf Gear Corp., Box 934, Syracuse, N. Y.
Greaves Machine Tool Co., 2011 Eastern Ave., Cincinnati, Ohio.

(Continued on page 234)

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FLAT—1/16" sheet—Square butt—One pass—1/32" Root opening—Welding speed 10 IPM.

VERTICAL UP—1/8" plate—Square butt—One pass—1/16" Root opening—Welding speed 9 IPM.

FLAT—1/8" plate—Square butt—One pass—1/16" Root opening—Welding speed 10 IPM.

VERTICAL UP—1/4" plate—Square butt weld—One pass—3/16" Root opening—Welding speed 3.25 IPM.

FLAT—1/4" plate—Square butt weld—One pass—3/16" Root opening—Welding speed 2.7 IPM.

VERTICAL UP—1/2" plate—Single V butt weld—60° Included angle—Zero root opening—Pass #1, Stringer bead at 7 IPM—Pass #2, Full weave at 3.9 IPM—Pass #3, Full weave at 2 IPM.

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Stahl Gear & Mch. Co., 3901 Hamilton Ave., Cleveland 14, Ohio
Verson Allsteel Press Co., 93rd St., & S. Kenwood Ave., Chicago, Ill.

GENERATORS, Electric

Reliance Electric & Engineering Co., 1200 Ivanhoe Rd., Cleveland 10, Ohio

GRADUATING MACHINES

Gorton, Geo., Mch. Co., 1321 Racine St., Racine, Wis.

GREASES—See Lubricating Oils and Greases

GRINDERS, Bench, Floor and Snag

Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh, Pa.
Jones & Lamson Mch. Co., Springfield, Vt.
Mummert-Dixon Co., Hanover, Pa.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDERS, Carbide Tool

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh, Pa.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Le Maire Tool & Mfg. Co., Dearborn, Mich.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDERS, Die and Mold

Norton Co., 1 New Bond St., Worcester 6, Mass.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDERS, Drill Point

Atlas Press Co., 20108 N. Pitcher, Kalamazoo, Mich.
Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Oliver Instrument Co., 1410 E. Maumee, Adrian, Mich. (also drill point thinner)
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio.

GRINDERS, Face Mill

Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Mattison Machine Works, 545 Blackhawk Park Ave., Rockford, Ill.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.

GRINDERS, Knife and Shear

Hill Acme Co., 1201 W. 65th St. Cleveland 2, Ohio
Mattison Machine Works, Rockford, Ill.
Mummert-Dixon Co., Hanover, Pa.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDERS, Portable Electric

Chicago Pneumatic Tool Co., New York 17, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati 4, Ohio.

GRINDERS, Portable Pneumatic

Chicago Pneumatic Tool Co., New York 17, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Madison-Kipp Corp., Madison, Wis.

GRINDERS, Tap

Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Jones & Lamson Mch. Co., 160 Clinton St., Springfield, Vt.

GRINDERS, Tool and Cutter

Atlas Press Co., 20108 N. Pitcher, Kalamazoo, Mich.
Barber-Colman Co., 1300 Rock St., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling and Grinding Mchs., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh, Pa.
Fellows Gear Shaper Co., 78 River St., Springfield, Vt.
Gallmeyer & Livingston Co., 336 Straight Ave., S. W., Grand Rapids 4, Mich.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Gorton, Geo., Mch. Co., 1321 Racine St., Racine, Wis.
Landis Tool Co., Waynesboro, Pa.
LeBlond, R. K., Mch. Tool Co. Madison and Edwards Rds., Cincinnati 18, Ohio
Mummert-Dixon Co., Hanover, Pa.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Norton Co., 1 New Bond St., Worcester 6, Mass.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Thompson Grinder Co., 1500 W. Main St., Springfield, Ohio

GRINDERS, Toolpost

Cosa Corp., 305 Lexington Ave., New York 17, N. Y.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDING GAGES—See Gages, Grinding

GRINDING MACHINES, Abrasive Belt

Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Mattison Mch. Works, Rockford, Ill.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDING MACHINES, Broach

Gallmeyer & Livingston Co., 336 Straight, S. W. Grand Rapids 2, Mich.
National Broach & Mch. Co., 5600 St. Jean, Detroit 13, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Thompson Grinder, 1534 W. Main, Springfield, Ohio

GRINDING MACHINES, Cam

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Landis Tool Co., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

GRINDING MACHINES, Centerless

Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Landis Tool Co., Waynesboro, Pa.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

GRINDING MACHINES, Crankshaft

Landis Tool Co., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

GRINDING MACHINES, Cylindrical

Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gallmeyer & Livingston Co., 336 Straight, S. W., Grand Rapids 2, Mich.
Landis Tool Co., Inc., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

GRINDING MACHINES, Disc

Brown & Sharpe Mfg. Co., Providence, R. I.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh 8, Pa.
Gardner Machine Co., Beloit, Wis.
Mattison Machine Works, Rockford, Ill.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDING MACHINES, Gear

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gear Grinding Mch. Co., 3901 Christopher St., Detroit 11, Mich.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING MACHINES, Internal

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gallmeyer & Livingston Co., 336 Straight, S.W., Grand Rapids 2, Mich.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Standard Electrical Tool Co. 2488-90 River Rd., Cincinnati, Ohio.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.
Wicaco Machine Corp., Wayne Junction, Philadelphia, Pa.

GRINDING MACHINES—Jig

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock St., Cincinnati 23, Ohio
Gallmeyer & Livingston Co., 336 Straight S.W., Grand Rapids 2, Mich.
Moore Special Tool Co., Inc., 740 Union Ave., Bridgeport, Conn.

GRINDING MACHINES, Profile

American Laubscher Corp., Fisk Bldg., 250 W 57 St., New York 19, N. Y.
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Jones & Lamson Mch. Co., Springfield, Vt
Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING MACHINES, Roll

Landis Tool Co., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.

GRINDING MACHINES, Surface Reciprocating

Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling and Grinding Mchs., Inc. Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Delta Power Tool Div., 400 Lexington Ave., Pittsburgh, Pa.
DoALL Co., Des Plaines, Ill.
Foote-Burt Co., 13000 St. Clair Ave., Cleveland 8, Ohio
Gallmeyer & Livington Co. 336 Straight, S.W. Grand Rapids 4, Wis.
Gardner Machine Co., Beloit, Wis.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Mattison Machine Works, Rockford, Ill.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Thompson Grinder Co., 1500 W. Main St., Springfield, Ohio.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

THE STRIPPIT FABRICATOR — a single compact multi-purpose Punch Press with quick-change tool holder, quick-set gauging and stops.

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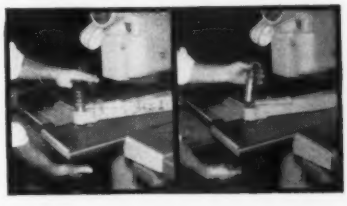
What's more, you can add the Strippit Positive Duplicator for high-speed punching in medium runs — plus the Dupl-O-Scope to punch Duplicator templates right from the drawing, in a few minutes. Write today for details and demonstration at your plant by the Strippit mobile unit. Warehouse stocks in Chicago and Los Angeles.



TOOL HOLDER is pulled out, for instant removal of die and punch assembly, ready for the next interchangeable tool. 1¼" diameter capacity holder shown. 3½" diameter holder also available.

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WALES STRIPPIT INC.
203 Buell Road, Akron, New York
In Canada: Strippit Tool & Machine Company, Brampton, Ontario

For more data, circle this page number on inquiry card

GRINDING MACHINES, Surface Rotary

Blanchard Machine Co., 64 State St., Cambridge, Mass.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gardner Machine Co., Beloit, Wis.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Mattison Machine Works, Rockford, Ill.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Thompson Grinder Co., 1500 W. Main St., Springfield, Ohio
Walker, O. S. Co., Inc., Worcester, Mass.

GRINDING MACHINES, Thread

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Jones & Lamson Mch. Co., Springfield, Vt.
Landis Machine Co. (Centerless), Waynesboro, Pa.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING MACHINES, Universal

Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gallmeyer & Livingston Co., 336 Straight, S.W., Grand Rapids 2, Mich.
Gorton Mch. Co., Geo., 1321 Racine St., Racine, Wis.
Jones & Lamson Mch. Co., Springfield, Vt.
Landis Tool Co., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Parker-Majestic, Inc. 147 Joseph Campau, Detroit, Mich.

GRINDING WHEEL DRESSING AND FORMING DEVICES

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
DoALL Co., Des Plaines, Ill.
Jones & Lamson Mch. Co., Springfield, Vt.
Metal Carbides Corp., Youngstown, Ohio
Moore Special Tool Co., Inc., 740 Union Ave., Bridgeport 7, Conn.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING WHEELS

Bay State Abrasive Co., Westboro, Mass.
Blanchard Machine Co., 64 State St., Cambridge, Mass.
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
Gardner Machine Co., Beloit, Wis.
Metal Carbides Corp., Youngtown, Ohio.
Norton Co., 1 New Bond St., Worcester 6, Mass.

HAMMERS, Drop—See Forging Hammers

HAMMERS, Portable Electric

Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

HAMMERS, Portable Pneumatic

Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

HAMMERS, Power

Chambersburg Engrg. Co., Chambersburg, Pa.
Edlund Mchry. Co. Div., Cortland, N. Y.
Erie Foundry Co., 1253 W. 12th St., Erie Penna.
Yoder Co., 5504 Walworth Ave., Cleveland 2, Ohio.

HARDNESS TESTERS

Shore Instrument & Mfg. Co., 90-35C Van Wyck Exp., Jamaica 35, N. Y.

HEAT-TREATING EQUIPMENT — See Annealing Furnaces, Flame Hardening Machines, Induction-Heating Equipment

HOBS

Barber-Colman Co., 1300 Rock St., Rockford, Ill.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
National Twist Drill & Tool Co., Rochester, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. Y.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.

HOISTS, Air

Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

HOISTS, Electric

Ingersoll-Rand Co. 11 Broadway, New York 4, N. Y.
Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y.

HONING MACHINES

Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Jes-Cal Co., Fraser Michigan
Micromatic Hone Corp., 8100 Schoolcraft Ave., Detroit 38, Mich.
Moline Tool Co., 102-120th St., Moline, Ill.
Superior Hone Corp., 1623 Elreno St., Elkhart, Inc.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

HONING STONES

Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Jes-Cal Co., Fraser, Michigan
Micromatic Hone Corp., 8100 Schoolcraft Ave., Detroit 38, Mich.
Norton Co., 1 New Bond St., Worcester 6, Mass.

HOSE

American Metal Hose Br. American Brass Co., 25 Broadway, New York, N. Y.
Schrader's Son, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.

HYDRAULIC MACHINERY
Tools and equipment

Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Bethlehem Steel Corp., Bethlehem, Pa.
Birdsboro Steel Fdry. & Mch. Co., Birdsboro, Pa.
Bliss, E. W., Co., 1375 Raff Rd., E. W. Canton, Ohio
Chambersburg Engrg. Co., Chambersburg, Pa.
Cross Co., 3250 Bellevue Ave., Detroit 7, Mich.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., Erie, Pa.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Michigan Drill Head Co., Detroit 34, Mich.
Modern Ind. Engrg. Co., 14230 Birwood Ave., Detroit 4, Mich.
Northern Hydraulics & Mch. Corp., Melrose Park Ill.
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Rockford Mch. Tool Co., 2500 Kishwaukee St., Rockford, Ill.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Verson Allsteel Press Co., 93rd St. & S. Kenwood Ave., Chicago, Ill.
Vickers Incorporated, Div. of Sperry Rand Corp., 1402 Oakman Blvd., Detroit, Mich.
Wilson, K. R., Inc., 211 Mill St., Arcade, N. Y.

HYDRAULIC POWER UNITS OR TOOL HEADS

Barnes Drill Co., 814 Chestnut, Rockford 3, Ill.
Barnes, W. F. & John Co., 201 S. Waterford St., Rockford, Ill.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford 12, Conn.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Le Maire Tool & Mfg. Co., Dearborn, Mich.
Michigan Drill Head Co., Detroit 34, Mich.
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Vickers Incorporated, Div. of Sperry Rand Corporation, 1402 Oakman Blvd., Detroit, Mich.

INDEXING and SPACING EQUIPMENT

Brown & Sharpe Mfg. Co., Providence, R. I.
Eisler Engrg. Co., Inc., 750 South 13th St., Newark, N. J.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Opto-Metric Tools, Inc., 137 Varick St., New York, N. Y.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.
Vinco Corp., 9111 Schaefer Highway, Detroit,

INDICATOR BASES, Magnetic

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
DoALL Co., Des Plaines, Ill.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Starrett, L. S. Co., Athol, Mass.

INDICATORS, Dial

Ames, B. C., Waltham 54, Mass.
Brown & Sharpe Co., Providence, R. I.
DoALL Co., 254 N. Laurel Ave., Des Plaines, Ill.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
National Automatic Tool Co., S. 7th - N. Sts., Richmond, Ind.
Starrett, The L. S. Co., Athol, Mass.

INDICATORS, Speed

Brown & Sharpe Mfg. Co., Providence, R. I.
Reliance Electric & Engineering Co., 1200 Ivanhoe Rd., Cleveland 10, Ohio
Starrett The L. S., Co., Athol, Mass.

INDICATORS, Test

Brown & Sharpe Mfg. Co., Providence, R. I.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
National Automatic Tool Co., S. 7th & N. Sts., Richmond, Ind.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Starrett, The L. S., Co., Athol, Mass.

INDUCTION HEATING EQUIPMENT

Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Lepel High Frequency Laboratories, Inc., Woodside 77, N. Y.
Ohio Crankshaft Co., 3800 Harvard Ave., Cleveland, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

INTENSIFIERS, Hydraulic

Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Logansport Mch. Co., Inc., Logansport, Ind.
Oilgear Co., 1560 W. Pierce St. Milwaukee 4, Wis.

JACKS, Planer—See Set-up Equipment

Saves Time... Cuts Costs

Rotary Planer • • • do milling jobs in one-third to one-seventh of time on an Espen-Lucas Rotary Planer.

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BUILDERS OF LARGE COLD SAWING MACHINES • ROTARY PLANERS • COLUMN FACERS • HEAVY TYPES OF SPECIAL MACHINERY

WHY MICROHONING*

OF GUIDE PIN BUSHINGS ASSURES FUNCTIONAL PRECISION, LONGER LIFE, LOWER COSTS

Lamina Dies and Tools, Inc., a pioneer in the development of bronze-plated guide pin bushings (bronze is electroplated on hardened steel for combined strength and smoother action), required a processing method that would economically produce bushing bores having dimensional precision, accurate geometry, functional surface characteristics, and consistent duplication to exacting specifications in every bushing.

In developing processing methods for the bushing bores, Lamina engineers found that Microhoning is best for generating final precision and functional surface characteristics at lowest cost per bushing.

Bronze, bronze-plated or steel bushings from ¾" to 4½" in diameter are Microhoned on this Hydrohoner. Stock removal is from .001" to .003" and average unit cycle is 30 seconds. Machine is equipped with automatic size control and tool expansion.

Characteristic cross-hatch lay pattern

Why? Because Microhoning generates a round, straight cylinder along the neutral axis of the bore; size and geometry of bushings up to 2½" in diameter are held to .0001" tolerances; contact area between bushing and guide pin is 25% greater than obtainable by other final processing methods. In addition, the characteristic cross-hatch lay pattern generated by Microhoning provides a "built-in" lubrication system in each bushing bore. This combined with the clean-cut surface prevents seizure or scuffing during operation of bushing. Finally, the self-dressing action of Microhoning abrasives assures continuous cutting efficiency and identical geometry, dimensions and surface finish in every bushing bore.

Thus, Lamina realizes, through Microhoning's generation of quality surfaces and precision bores, the full performance potential of bronze, bronze-plated or steel guide pin bushings—longer life, smoother action, lower costs.

Learn how Microhoning provides efficient stock removal, closer tolerances and functional surfaces—SEND FOR FREE LITERATURE.

*Registered U.S. Patent Office

MICROMATIC HONE CORP.
8100 SCHOOLCRAFT AVENUE · DETROIT 38, MICHIGAN

JIG BORERS

American Sip Corp., 100 E. 42nd St., New York 17, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
DeVlieg Machine Co., Fair St., Royal Oak, Mich.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio
Moore Special Tool Co., Inc., 740 Union Ave., Bridgeport, Conn.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

JIGS AND FIXTURES

Bath, Cyril Co., Aurora & Solon Road, Solon, Ohio
Columbus Die Tool & Mch. Co., 955 Cleveland Ave., Columbus, Ohio
Hartford Special Mchry. Co., 287 Homestead Ave., Hartford, Conn.
Metal Carbides Corp., Youngstown 12, Ohio
Sheffield Corp., 721 Springfield St., Dayton 1, Ohio

KEYSEATERS

Baker Bros., Inc., Station F, P. O. Box 101, Toledo 10, Ohio
Bliss, E. W. Co., Canton, Ohio
Mitts & Merrill, 1809 S. Water St., Saginaw, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

KNURLING TOOLS

Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Reed Rolled Thread Die Co., P. O. Box 350, Worcester 1, Mass.

LAPPING MACHINES

Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Crane Packing Co., 6400 Oakton St., Morton Grove, Ill.
DoALL Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Gleason Works, 1000 University Ave., Rochester, N. Y.
Micromatic Hone Corp., 8100 Schoolcraft Ave., Detroit 38, Mich.
Norton Co., 1 New Bond St., Worcester 6, Mass.

LATHE ATTACHMENTS

Atlas Press Co., Kalamazoo, Mich.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Sheldon Mch. Co., Inc., 4258 N. Knox Ave., Chicago 41, Ill.

LATHES, AUTOMATIC—See Chucking Machines

LATHES, Axle

Consolidated Mch. Tool Div., Farrel-Birmingham Co., Inc., Rochester 10, N. Y.
Monarch Mch. Tool Co., Oak St., Sidney, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

LATHES, Bench

Atlas Press Co., Kalamazoo, Mich.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio.
Sheldon Mch. Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.

LATHES, Car Wheel
Bullard Co., Bridgeport 6, Conn.
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.

LATHES, Copying, Duplicating — See Lathes, Duplicating

LATHES, Crankshaft
Consolidated Mch. Tool Corp., Rochester, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

LATHES, Double-End
Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio
Consolidated Mch. Tool Corp., Rochester, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2351 11th St., Rockford, Ill.

LATHES, Duplicating
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Monarch Machine Tool Co., 27 Oak St., Sidney, Ohio
Sidney Machine Tool Co., Sidney, Ohio

LATHES, Engine, Manufacturing
American Tool Works Co., Pearl and Eggleston Aves., Cincinnati, Ohio
Atlas Press Co., Kalamazoo, Mich.
Cincinnati Lathe & Tool Co., 3207 Disney St., Cincinnati 9, Ohio
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
Hendey Mch. Div., Barber Colman Co., Rockford, Ill.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Monarch Machine Tool Co., 27 Oak St., Sidney, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Rockford Machine Tool Co., 2500 Kishwaukee St., Rockford, Ill.
Sheldon Mch. Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.

LATHES, Engine, Toolroom
American Tool Works Co., Pearl and Eggleston Aves., Cincinnati, Ohio
Atlas Press Co., Kalamazoo, Mich.
Cincinnati Lathe & Tool Co., 3207 Disney St., Cincinnati 9, Ohio
Hardinge Bros. Inc., 1420 College Ave., Elmira, N. Y.
Hendey Mch. Div., Barber Colman Co., Rockford, Ill.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerai Ave., Cincinnati 25, Ohio
Logan Engineering Co., 4901 Lawrence Ave., Chicago 30, Ill.
Monarch Machine Tool Co., 27 Oak St., Sidney, Ohio
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Rockford Machine Tool Co., 2500 Kishwaukee St., Rockford, Ill.
Sheldon Mch. Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.

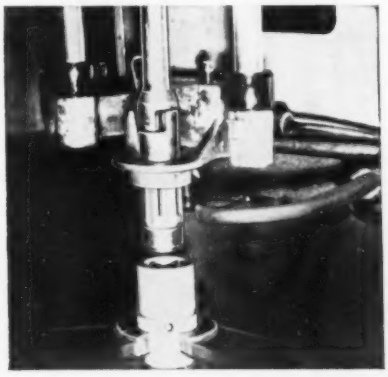
LATHES, Gap
Atlas Press Co., Kalamazoo, Mich.
Cincinnati Lathe & Tool Co., 3207 Disney St., Cincinnati 9, Ohio
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio

LATHES, Hollow Spindle
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
South Bend Lathe Works Inc., 425 E. Madison St., South Bend, Ind.

HOW MICROHONING* OF GUIDE PIN BUSHINGS PROVIDES FUNCTIONAL PRECISION, LONGER LIFE, LOWER COSTS

HERE'S HOW Lamina Dies and Tools, Inc. uses Microhoning to generate final precision and functional surface characteristics in bushing bores at minimum cost.

Microhoning's low-velocity, controlled abrading technique removes a minimum of the bronze plating to obtain accuracy and functional surface characteristics. Thus, as much as possible of bronze plating is conserved and a uniform thickness of bronze throughout the bore is assured.



Above is a typical Lamina guide pin bushing. These bushings range in diameter from ¾" to 4½". An air operated, three-jaw fixture rigidly holds the work piece and is easily adapted to bushings of any size.

Because Microhoning tools have universal joints, they follow the neutral axis of the bore in generating round, straight cylinders. Since the bore location remains unchanged, concentricity between bushing I.D. and O.D. is obtained.

The combined reciprocating and rotating motions of the Microhoning tool creates on the bore surface a cross-hatch lay pattern that functions as a "built-in" lubricating system. For, the multitude of minute, diamond-shaped plateaus—over which the load is evenly distributed—are separated by a network of valleys that holds the lubricant. This better method of lubrication plus the clean-cut Microhoned surface prevent seizure or scuffing of bronze, bronze-plated and steel bushings. And, the self-dressing action of Microhoning abrasives maintains cutting efficiency to assure the same surface finish is developed in every bushing bore.

Learn how Microhoning provides efficient stock removal, closer tolerances and functional surfaces—SEND FOR FREE LITERATURE.

*Registered U.S. Patent Office

MICROMATIC HONE CORP.
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. . . now your distributor can supply **both**

Bunting®

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Fast pick-up...

Stock sizes of Bunting Cast Bronze and Sintered Bronze Bearings and Bars are available everywhere in America. Every one is a precision product of scientifically exact manufacturing methods, meeting on every point the highest standards of quality as defined by modern mechanical engineering and metallurgy.

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Distributors Associations
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Your Bunting distributor is listed in the classified section of your telephone directory usually under Bars — Bronze, and Bearings — Bronze. Two Bunting factories and eleven Bunting Branch Warehouses expedite distribution in all areas. Ask your local Bunting distributor or write for catalogs.

Bunting®

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Ask for
Catalog No. 58-Cast Bronze and Sintered Bronze Bearings and Bars
Catalog No. 258-Electric Motor Bearings and Cast Bronze Bars

THE BUNTING BRASS AND BRONZE COMPANY • TOLEDO 1, OHIO • BRANCHES IN PRINCIPAL CITIES

LATHES, Roll
American Tool Works Co., Pearl and Eggleston Aves., Cincinnati 2, Ohio
Bliss, E. W., Co., Canton, Ohio
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Monarch Mch. Tool Co., Oak St., Sidney, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City, 2, N. J.

LATHES, Speed, Second-operation
Atlas Press Co., Kalamazoo, Mich.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Monarch Mch. Tool Co., Oak St., Sidney, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sheldon Mch. Co., 4258 N. Knox Ave., Chicago 41, Ill.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio

LATHES, Spinning
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Lodge & Shipley Co., The, Cincinnati 25, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

LATHES, Toolroom—See Lathes, Engine, Toolroom

LATHES, Turret, Automatic
Atlas Press Co., Kalamazoo, Mich.
Bullard Co., Bridgeport 2, Conn.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
King Machine Tool Div., American Steel Foundreis, 1150 Tennessee Ave., Cincinnati 29, Ohio
National Acme Co., 170 E. 131st St., Cleveland 3, Ohio
New Britain Mch. Co., New Britain-Gridley Div., New Britain, Conn.

LATHES, Turret, Ram Type Saddle Type
Atlas Press Co., Kalamazoo, Mich.
Bullard Co., Bridgeport 2, Conn.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Hardinge Brothers, Inc., 1420 College Ave., Elmira, N. Y.
Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
New Britain Mch. Co., New Britain-Gridley Div., New Britain, Conn.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sheldon Mach. Co., Inc., 4258 N. Knox Ave., Chicago 41, Ill.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio

LATHES, Turret, Vertical—See Boring Mills, Vertical

LAYOUT and DRAFTING TOOLS
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Starrett, L. S., Co., Athol, Mass.

LEVELS
Starrett, The L. S., Co., Athol, Mass.

LIMIT SWITCHES—See Switches, Limit

LUBRICATING OILS and GREASES
Bearings, Inc., 3634 Euclid Ave., Cleveland 15, Ohio
Cities Service Oil Co., 70 Pine St., New York, N. Y.

(Continued on page 242)

GEARS

Made to Your Specifications

You and we can form a team—you to draw up the specifications; we to make the gears—that will be profitable to both of us. Gears of all types, all sizes, all materials. Design-engineering service available.

Custom Gears Exclusively

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Syracuse 1, N. Y.

DIEFENDORF GEARS

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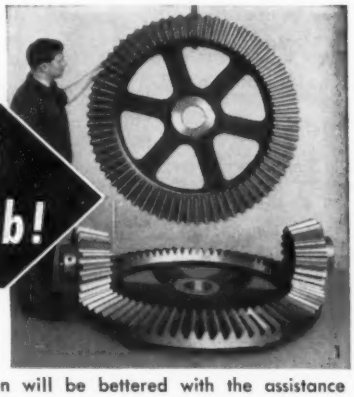

Geared to the Job!

Agitator tank operation will be bettered with the assistance of this perfectly matched set, comprised of 2 steel bevel gears weighing 1900 pounds each, and 2 steel bevel pinions of 510 pounds each. Specifications of 56.4" O.D., 7" F., 70 T., 1¼ D.P. and 15.95" O.D., 7" F., 18 T., 1¼ D.P., respectively, were met precisely. Stahl's progressive experience is at your disposal. Send for estimate.

SPURS TO 72" PD. 1 DP

BEVELS TO 54" PD. 1 DP

SPIRAL, HELICAL and WORM GEARS TO 48" PD. 2 DP

CONTINUOUS TOOTH HERRINGBONE TO 60" PD. 2 DP

SPROCKETS TO 72" PD. 2½" CP

RACKS TO 20 FT. LONG. 3 DP

SILENT GEARS: RAWHIDE, BAKELITE, FIBROIL

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GEAR & MACHINE COMPANY

3901 HAMILTON AVENUE

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BEVEL GEARS— BEVEL PINIONS with LONG STEMS

by

BILGRAM!

Long stemmed bevel gears and bevel pinions of almost any length! Here's a special kind of gear work that requires extensive know-how and the right kind of equipment in order to produce gears that will give dependable performance and meet your ideas of precision and price.

We are equipped—both with the machines and the skill—to produce gears for your every requirement: Bevels of all kinds . . . Ellipticals . . . Herringbones . . . Helicals . . . Racks . . . Spurs . . . Hypoids . . . Worms and Worm Gears. Get a BILGRAM estimate on your next job and be convinced!

FOR ALL YOUR GEAR NEEDS

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BILGRAM

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Manufacturers of Bevel Gear Generators and Chamfering Machines

1217-35 SPRING GARDEN ST.

PHILADELPHIA 23, PA.

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. . . now your distributor can supply **both**

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Fast pick-up...

Stock sizes of Bunting Cast Bronze and Sintered Bronze Bearings and Bars are available everywhere in America. Every one is a precision product of scientifically exact manufacturing methods, meeting on every point the highest standards of quality as defined by modern mechanical engineering and metallurgy.

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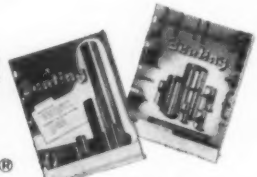

Bunting®

BUSHINGS, BEARINGS, BARS, AND SPECIAL PARTS OF CAST BRONZE AND POWDERED METAL

Ask for
Catalog No. 58-Cast Bronze and Sintered Bronze Bearings and Bars
Catalog No. 258-Electric Motor Bearings and Cast Bronze Bars

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American Tool Works Co., Pearl and Eggleston Aves., Cincinnati 2, Ohio
Bliss, E. W., Co., Canton, Ohio
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Atlas Press Co., Kalamazoo, Mich.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Monarch Mch. Tool Co., Oak St., Sidney, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sheldon Mch. Co., 4258 N. Knox Ave., Chicago 41, Ill.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio

LATHES, Spinning
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Lodge & Shipley Co., The, Cincinnati 25, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

LATHES, Toolroom—See Lathes, Engine, Toolroom

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Atlas Press Co., Kalamazoo, Mich.
Bullard Co., Bridgeport 2, Conn.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
King Machine Tool Div., American Steel Foundreis, 1150 Tennessee Ave., Cincinnati 29, Ohio
National Acme Co., 170 E. 131st St., Cleveland 3, Ohio
New Britain Mch. Co., New Britain-Gridley Div., New Britain, Conn.

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Atlas Press Co., Kalamazoo, Mich.
Bullard Co., Bridgeport 2, Conn.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Hardinge Brothers, Inc., 1420 College Ave., Elmira, N. Y.
Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
New Britain Mch. Co., New Britain-Gridley Div., New Britain, Conn.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sheldon Mach. Co., Inc., 4258 N. Knox Ave., Chicago 41, Ill.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio

LATHES, Turret, Vertical—See Boring Mills, Vertical

LAYOUT and DRAFTING TOOLS
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Starrett, L. S., Co., Athol, Mass.

LEVELS
Starrett, The L. S., Co., Athol, Mass.

LIMIT SWITCHES—See Switches, Limit

LUBRICATING OILS and GREASES
Bearings, Inc., 3634 Euclid Ave., Cleveland 15, Ohio
Cities Service Oil Co., 70 Pine St., New York, N. Y.

(Continued on page 242)

GEARS

Made to Your Specifications

You and we can form a team—you to draw up the specifications; we to make the gears—that will be profitable to both of us. Gears of all types, all sizes, all materials. Design-engineering service available.

Custom Gears Exclusively

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Syracuse 1, N. Y.

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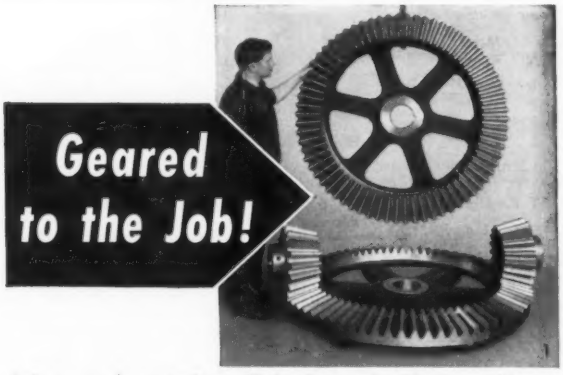

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SPURS TO 72" PD. 1 DP

BEVELS TO 54" PD. 1 DP

SPIRAL, HELICAL and WORM GEARS TO 48" PD. 2 DP

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SPROCKETS TO 72" PD. 2½" CP

RACKS TO 20 FT. LONG. 3 DP

SILENT GEARS: RAWHIDE, BAKELITE, FIBROIL

HEAT TREATED CASE OR FLAME HARDENED GEARS—OF CARBON OR ALLOY STEEL

Stahl

GEAR & MACHINE COMPANY

3901 HAMILTON AVENUE

CLEVELAND 14, OHIO

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BEVEL GEARS— BEVEL PINIONS with LONG STEMS

by

BILGRAM!

Long stemmed bevel gears and bevel pinions of almost any length! Here's a special kind of gear work that requires extensive know-how and the right kind of equipment in order to produce gears that will give dependable performance and meet your ideas of precision and price.

We are equipped—both with the machines and the skill—to produce gears for your every requirement: Bevels of all kinds . . . Ellipticals . . . Herringbones . . . Helicals . . . Racks . . . Spurs . . . Hypoids . . . Worms and Worm Gears. Get a BILGRAM estimate on your next job and be convinced!

FOR ALL YOUR GEAR NEEDS

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BILGRAM

GEAR & MACHINE WORKS

Manufacturers of Bevel Gear Generators and Chamfering Machines

1217-35 SPRING GARDEN ST.

PHILADELPHIA 23, PA.

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Shell Oil Co., 50 W. 50th St., New York, N. Y.
Standard Oil Co. (Indiana), 910 S. Michigan, Chicago, Ill.
Texas Co., 135 E. 42nd St., New York, N. Y.

LUBRICATING SYSTEMS
Gits Bros. Mfg. Co., 1846 S. Kilbourn Ave., Chicago 23, Ill.
Madison-Kipp Corp., Madison, Wis.

MACHINERY, Used and Rebuilt
Eastern Mchry. Co., 1000 Tennessee Ave., Cincinnati, Ohio
Miles Mchry. Co., 2025 E. Genessee Ave., Saginaw, Mich.
Van Keuren Co., Watertown 72, Mass.

MACHINISTS' SMALL TOOLS
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Niagara Mch. & Tool Wks., 637-697 Northland Ave., Buffalo 11, N. Y.
Starrett, The L. S., Co., Athol, Mass.

MANDRELS—See Arbors and Mandrels

MARKING MACHINES and DEVICES
Gorton Mch. Co., 1321 Racine St., Racine Wis.

MATERIAL-HANDLING TRUCKS—See Trucks, Material Handling

MEASURING MACHINES
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheffield Corp., 721 Springfield St., Dayton, 1, Ohio

MEASURING WIRES—Thread, Spline, Gear
Sheffield Corp., Dayton 1, Ohio
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.

MICROMETER HEADS
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
DoALL Co., Des Plaines, Ill.
Starrett, The L. S., Co., Athol, Mass.

MICROMETERS, Outside, Inside, Depth
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
DoALL Co., 254 N. Laurel Ave., Des Plaines, Ill.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.
Starrett, The L. S., Co., Athol, Mass.

MICROSCOPES, Toolmakers'
Bausch & Lamb Optical Co., Rochester, N. Y.
DoALL Co., Des Plaines, Ill.
Opto-Metric Tools, Inc., 137 Varick St., New York, N. Y.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

MILLING MACHINE ATTACHMENTS
Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling & Grinding Mches, Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Fred-Tex Machine, Inc., Fredericksburg, Tex.
G & L and Hypro Div., Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
Gorton, George Mch. Co., 1110 W. 13th St., Racine, Wis.
Greaves Mch. Tool Div., 2011 Eastern Ave., Cincinnati 2, Ohio
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Nichols, W. H. Co., Waltham 54, Mass.
Sheldon Mch. Co., Inc., 4258 N. Knox Ave., Chicago 41, Ill.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

MILLING MACHINES, Automatic
Cincinnati Milling Machine Co., Cincinnati, Ohio
Consolidated Machine Tool Corp., Rochester, N. Y.
Cross Co., 3250 Bellevue Ave., Detroit 7, Mich.
Jones & Lamson Mch. Co., 160 Clinton St., Springfield, Vt.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Nichols, W. H. Co., Waltham 54, Mass.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.

MILLING MACHINES, Bed Type, Simplex, Duplex
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Cincinnati Milling & Grinding Mches., Inc., 470 Marburg Ave., Cincinnati 9, Ohio
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Espen-Lucas Mch. Wrks., Front St., and Girard Ave., Philadelphia, Pa.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Nichols, W. H. Co., Waltham 54, Mass.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

MILLING MACHINES, Bench, Hand
Atlas Press Co., Kalamazoo, Mich.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Nichols, W. H. Co., Waltham 54, Mass.

MILLING MACHINES, Circular, Continuous
Consolidated Mch. Tool Corp., Rochester, N. Y.
Davis & Thompson Co., 6411 W. Burnham St., Milwaukee 14, Wis.
Espen-Lucas Mch. Works, Front St. and Girard Ave., Philadelphia, Pa.
Nichols, W. H. Co., Waltham 54, Mass.
Snyder Tool & Engrg. C., 3400 E. Lafayette, Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2351 11th St., Rockford, Ill.

MILLING MACHINES, Die Sinking, Duplicating, Profiling
Arrow Engineering Co., 120 E. Market St., Indianapolis, Ind.
Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
G & L and Hypro Div., Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
Gorton, George, Machine Co., 1110 W. 13th St., Racine, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Nichols, W. H. Co., Waltham 54, Mass.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

MILLING MACHINES, Knee Type, Horizontal, Plain, Universal
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Co., Bridgeport 6, Conn.
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gorton Geo., Mch., Co., 1110 W. 13th St., Racine, Wis.
Greaves Machine Tool Div., 2009 Eastern Ave., Cincinnati, Ohio
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Nichols, W. H. Co., Waltham 54, Mass.
Sheldon Machine Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.

MILLING MACHINES, Knee Type Rise and Fall
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Nichols, W. H. Co., Waltham 54, Mass.
Orban, Kurt Co., 42 Exchange Place, Jersey City, N. J.

MILLING MACHINES, Knee Type Ram
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Gorton Mch. Co., 1321 Racine St., Racine, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

MILLING MACHINES, Knee Type Turret
Gorton Mch. Co., 1321 Racine St., Racine, Wis.

MILLING MACHINES, Knee Type, Vertical
Atlas Press Co., Kalamazoo, Mich.
Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 450 Lexington Ave., New York 17, N. Y.
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Nichols, W. H. Co., Waltham 54, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.

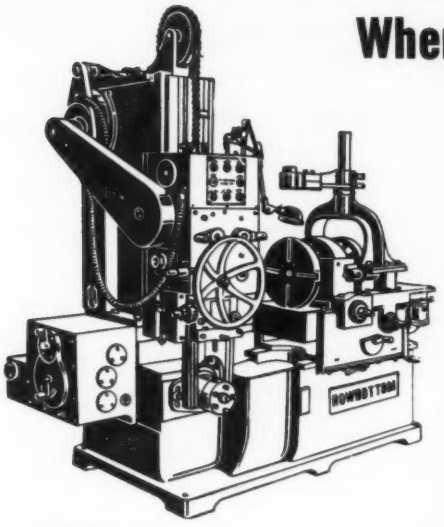
MILLING MACHINES, Planer Type
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Espen-Lucas Mch. Works, Front St. and Girard Ave., Philadelphia, Pa.
G & L and Hypro Div., Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
Gray, G. A., Co., Woodburn Ave. and Penn R.R., Evanston, Cincinnati, Ohio
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

MILLING MACHINES, Spar
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
G & L and Hypro Div., Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

MOLDING MACHINES, Plastic
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Fellows Gear Shaper Co., 78 River St., Springfield, Vt.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio

MOTORS, Air
Ingersoll-Rand Co., Phillipsburg, N. J.

Rowbottom for Cams



When it comes to CAMS . . .
come to ROWBOTTOM

There's no doubt about the fact that to think of cams is to think of Rowbottom. This is a natural association of ideas and stems from Rowbottom's pioneering in cam manufacturing for more than half a century.

This highly specialized experience places Rowbottom in a position to render a comprehensive, inclusive and practical service in producing cams of all types for all kinds of application. Furthermore, it provides the "know-how" to meet the most exacting specifications of designers and production men promptly and economically.

Next time you need cams, regardless of the quantity involved, take advantage of Rowbottom's complete facilities. You specify . . . we'll produce.

Send for new engineering bulletins on cams, cam-making equipment and rotary profiling just off the press.

THE ROWBOTTOM MACHINE COMPANY
WATERBURY CONNECTICUT

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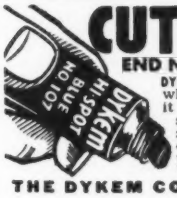
DYKEM STEEL BLUE
Stops Losses making Dies and Templates

Popular package is 8-oz. can fitted with Bakelite cap holding soft-hair brush for applying right at bench; metal surface ready for layout in a few minutes. The dark blue background makes the scribed lines show up in sharp relief, prevents metal glare. Increases efficiency and accuracy.

Write for sample on company letterhead

THE DYKEM COMPANY
2303R North 11th St. • St. Louis 6, Mo.

CUT SCRAPER TIME
END NIGHT CLEANUP & MORNING REBLUING



DYKEM HI-SPOT BLUE No. 107 is used to locate high spots when scraping bearing surfaces. As it does not dry, it remains in condition on work indefinitely, saving scraper's time. Intensely blue, smooth paste spreads thin, transfers clearly. No grit; noninjurious to metal. Uniform. Available in collapsible tubes of three sizes. Order from your supplier. Write for free sample tube on company letterhead.

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JIG AND FIXTURE DESIGN

A practical book with 382 pages of information on the design and construction of jigs and fixtures for drilling, boring, planing and milling. $5 per copy. Sent on approval.

MACHINERY, 93 Worth St., New York 13, N. Y.

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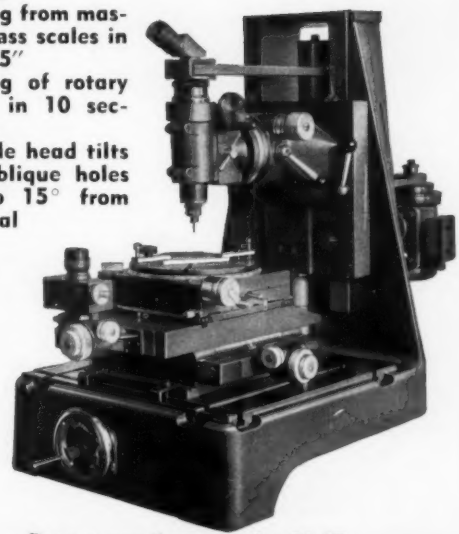
- **Capacity of coordinate table 6" x 6"**
- **Setting from master glass scales in .00005"**
- **Setting of rotary table in 10 seconds**
- **Spindle head tilts for oblique holes up to 15° from vertical**



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MOTORS, Electric
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
Lincoln Electric Co., Cleveland 17, Ohio
Reliance Electric & Engineering Co., 1200 Ivanhoe Rd., Cleveland 10, Ohio

MOTORS, Hydraulic
Barnes J. S., Corp., Rockford, Ill.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hydraulic Press Mfg. Div., Mt. Gilead, Ohio
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Vickers, Inc., Detroit 32, Mich.

MULTIPLE INSPECTION GAGES—See Gages, Multiple Inspection

MULTIPLE-STATION MACHINES, Dial Type
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Baush Mch. Tool Co., 15 Wason Ave., Springfield, Mass.
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Greenlee Bros. & Co., 2136 12th St., Rockford, Ill.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Kingsbury Mch. Tool Corp., Keene, N. H.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
National Automatic Tool Co., S. 7th N. St. Richmond, Ind.
Snyder Corp., 3400 E. Lafayette Ave., Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2531 - 11th St., Rockford, Ill.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.

MULTIPLE-STATION MACHINES, Transfer Type
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Baush Mch. Tool Co., 15 Wason Ave., Springfield, Mass.
Buhr Mch. Tool Co., 839 Green St., Ann Arbor, Mich.
Bullard Co., Bridgeport 6, Conn.
Cincinnati Milling Mch. Co., Cincinnati 9, Ohio
Clearing Mch. Corp., 6499 W. 65th St., Chicago 38, Ill.
Davis & Thompson Co., 4460 N. 124th St., Milwaukee 10, Wis.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Greenlee Bros. & Co., 2136 - 12th St., Rockford, Ill.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford Conn.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Le Maire Tool & Mfg. Co., Dearborn, Mich.
Moline Tool Co., 102-20th St., Moline, Ill.
National Automatic Tool Co., S. 7th N. Sts., Richmond, Ind.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Snyder Corp., 3400 E. Lafayette Ave., Detroit 7, Mich.
Sundstrand Mch., Tool Co., 2531 11th St., Rockford, Ill.
Verson Allsteel Press Co., 9399 S. Kenwood Ave., Chicago 19, Ill.
Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.

NIBBLING MACHINES
Wales-Strippit Corp., Akron, N. Y.

NUT SETTERS—See Screwdrivers, etc.

NUTS—See Bolts, Nuts and Screws

OIL GROOVERS
Wicaco Machine Corp., Wayne Junction, Philadelphia, Pa.

OILERS AND LUBRICATORS
Gits Bros. Mfg. Co., 1858 S. Kilbourn Ave., Chicago, Ill.
Madison-Kipp Corp., Madison, Wis.
Wicaco Mch. Corp., Philadelphia, Pa.

OILS, CUTTING SOLUBLE—See Cutting and Grinding Fluids

OILS, Lubricating—See Lubricating Oils and Greases

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Shell Oil Co., 50 W. 50th St., New York, N. Y.
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Standard Oil Co. (Indiana), 910 S. Michigan Ave., Chicago 80, Ill.

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Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.

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DoALL Co., Des Plaines, Ill.
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Starrett, The L. S., Co., Athol, Mass.
Walker, O. S., Co., Inc., Worcester, Mass.

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Mummert-Dixon Co., Hanover, Pa.

PIPE, Steel, Stainless, etc.
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Carpenter Steel Co., 105 W. Bern St., Reading, Penna.
Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.
United States Steel Corp., National Tube Co., Div., 436 7th Ave., Pittsburgh, Pa.

PIPE AND TUBING MILLS, Electric-weld
Yoder Co., 5504 Walworth Ave., Cleveland 2, Ohio

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American Brass Co., 25 Broadway, New York, N. Y.
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Revere Copper & Brass Inc., 230 Park Ave., New York 17, N. Y.

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Gray, G. A. Co., 3611 Woodburn Ave., Cincinnati, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Rockford Machine Tool Co., 2500 Kishwaukee St., Rockford, Ill.

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Eastman Kodak Co., 343 State St., Rochester 4, N. Y.
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PRESS BRAKES—See Brakes, Press and Bending

PRESS FEEDER, Automatic
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Federal Press Co., 511 Division St., Elkhart, Ind.
Producto Machine Co., 985 Housatonic Ave., Bridgeport 1, Conn.
U. S. Tool Co., 255 N. 18th St., Ampere, East Orange, N. J.

PRESSES, Arbor
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Dake Corp., 604 Monroe St., Grand Haven, Mich.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Logansport Machine Co., Inc., Logansport, Ind.
Threadwell Tap & Die Corp., 16 Arch St., Greenfield, Mass.

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Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Dake Corp., 604 Monroe Ct., Grand Haven, Mich.
Denison Engineering Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Press Co., 511 Division St., Elkhart, Ind.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Northern Hydraulics & Mach. Corp., Melrose Park, Ill.

PRESSES, Blanking, Stamping
Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
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Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
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Danly Machine Specialties, Inc., 2100 South Laramie, Chicago 50, Ill.
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Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E. Warren, Ohio
Federal Press Co., 511 Division St., Elkhart, Ind.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
U. S. Tool Co., Inc., 255 N. 8th St., Ampere, East Orange, N. J.
V & O Press Co., Hudson, New York
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.

PRESSES, Briquetting
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Denison Engineering Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio

PRESSES, Closed-Die Forging
Ajax Manufacturing Co., 1441 Chardon Rd., Cleveland 17, Ohio
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Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.

PRESSES, Coining, Embossing
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.

(Continued on page 246)

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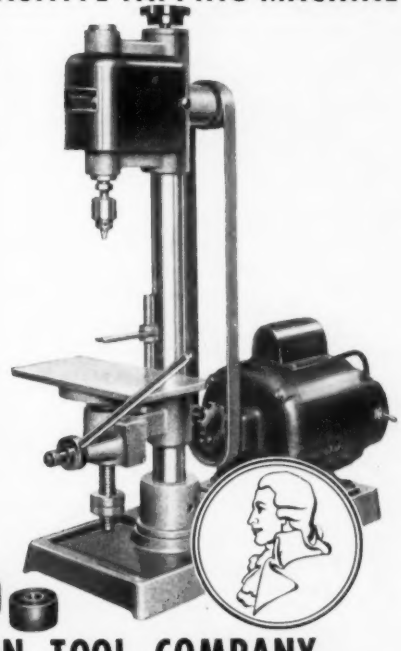

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Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Pa.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.

PRESSES, Die Sinking (Hobbing)

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Dake Corp., 604 Monroe St., Grand Haven, Mich.
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Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
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Dake Corp., 604 Monroe St., Grand Haven, Mich.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio
Federal Press Co., 511 Division St., Elkhart, Ind.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Producto Machine Co., 985 Housatonic Ave., Bridgeport 1, Conn.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.

PRESSES, Drawing

Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Cincinnati Milling & Grinding Machines, Inc., 4710 Marburg Ave., Cincinnati 9, Ohio
Clearing Machine Corp., 6399 W. 65th St., Chicago 38, Ill.
Cleveland Crane & Engineering Co., Wickliffe, Ohio
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Danly Machine Specialties, Inc., 2100 South Laramie, Chicago 50, Ill.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.

PRESSES, Extrusion

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Danly Machine Specialties, Inc., 2100 South Laramie, Chicago 50, Ill.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Pa.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.

PRESSES, Foot

Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Producto Machine Co., 985 Housatonic Ave., Bridgeport 1, Conn.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.

PRESSES, Horning

Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Dake Corp., 604 Monroe St., Grand Haven, Mich.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
V & O Press Co., Hudson, New York
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.

PRESSES, Notching

Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
V & O Press Co., Hudson, New York
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wales-Strippit Corp., Akron, N. Y.

PRESSES, Punching, Piercing

Batemen Fdry. & Mche., Mineral Wells, Tex.
Beatty Machine & Mfg. Co., Hammond, Ind.
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Crane & Engineering Co., Wickliffe, Ohio
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Dake Corp., 604 Monroe St., Grand Haven, Mich.
Danly Machine Specialties, Inc., 2100 South Laramie, Chicago 50, Ill.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio
Federal Press Co., 511 Division St., Elkhart, Ind.
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wales-Strippit Co., Akron, N. Y.
Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.
Wiedemann Machine Co., Gulph Rd., King of Prussia, Penna.

PRESSES, Quenching

Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Gleason Wks., 1000 University Ave., Rochester 3, N. Y.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio

PRESSES, Rubber-Forming

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Cincinnati Milling & Grinding Machines, Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Dake Corp., 604 Monroe St., Grand Haven, Mich.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.

PRESSES, Trimming

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Dake Corp., 604 Monroe St., Grand Haven, Mich.
Danly Machine Specialties, Inc., 2100 South Laramie, Chicago 50, Ill.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio.
Federal Press Co., 511 Division St., Elkhart, Ind.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.

PROFILING MACHINES—See Milling Machines, Die Sinking, etc.

PROTECTORS, Thread & Tube

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PULLEYS

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Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.

PUMPS, Coolant and Lubricant

Barnes, John S., Corp., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
Graymills Co., 3705 N. Lincoln Ave., Evanston, Ill.
Ingersoll-Rand Co., Phillipsburg, N. J.
Little Giant Pump Co., 5101 Classen Blvd., Oklahoma City 18, Oklahoma
Logansport Machine Co., Inc., 810 Center Ave., Logansport, Ind.
Ruthman Machinery Co., 1809 Reading Rd., Cincinnati 2, Ohio

PUMPS, Hydraulic

American Engineering Co., Wheatsheaf Lane & Sepviva St., Philadelphia 37, Penna.
Barnes, John S., Corp., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Hydraulic Press Mfg. Div., Mount Gilead, Ohio
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.

(Continued on page 248)

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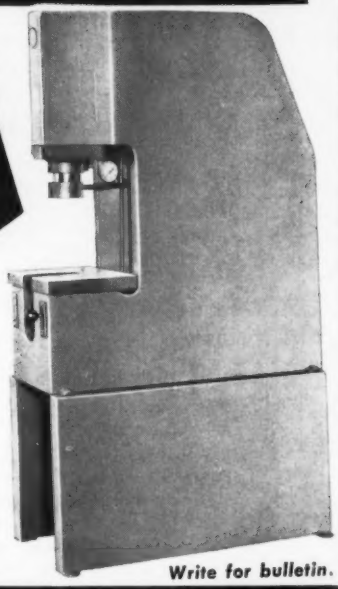

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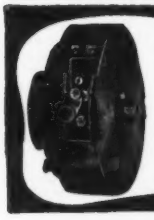

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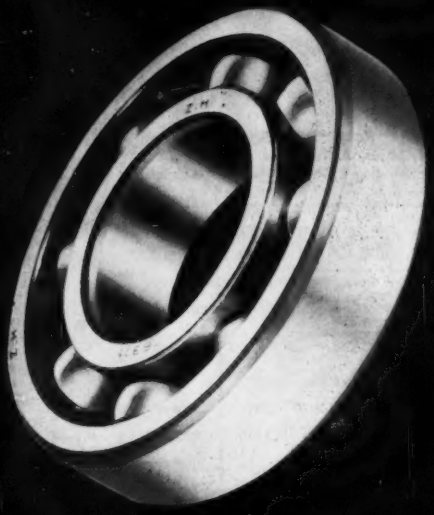

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Sundstrand Machine Tool Co., 2531 11th St., Rockford, Ill.
Vickers Incorporated, Division of Sperry Rand Corp., 1402 Oakman Blvd., Detroit, Mich.

PUNCHES AND DIES—See Dies, Blanking, etc.

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Capewell Mfg. Co., 60 Governor St., Hartford, Conn.
Circular Tool Co., Inc., 765 Allens Ave., Providence 5, R. I.
DoALL Co., 254 Laurel Ave., Des Plaines, Ill.
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Simonds Saw & Steel Co., 470 Main St., Fitchburg, Mass.
Starrett, The L. S., Co., Athol, Mass.

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Espen-Lucas Machine Works, Front St. and Girard Ave., Philadelphia, Pa.

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SAWING MACHINES, Band
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Cutron Mfg. Co., Lubbock, Texas
Delta Power Tool Div., Rockwell Mfg. Co., 400 N. Lexington Ave., Pittsburgh 8, Pa.
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Chicago Pneumatic Tool Co., 6 E. 44th St., New York 17, N. Y.

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Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
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Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Scully-Jones & Co., 1906 Rockwell St., Chicago 8, Ill.

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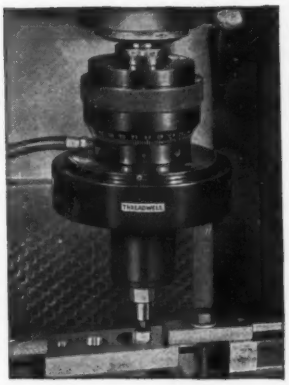

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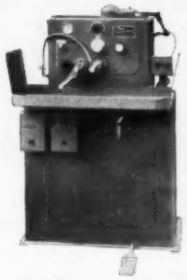

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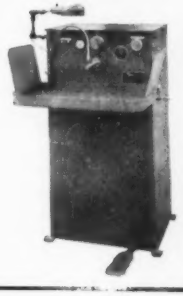

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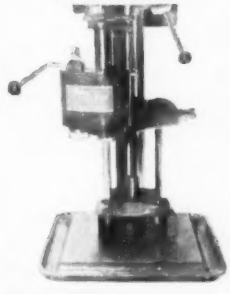

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GRINDERS, UNIV. 14" x 14" Mod. 112 Rivett
GRINDERS, CYL. 20" x 72" Landis, 1943
GRINDER, INT. 72A5 Heald, Univ., Hydr.
GRINDER, INT. No. 74 Heald Hydr., 1941
GRINDER, SURF 8" x 24" DoAll hydr. 1948
GRINDER, SURF. 20" x 24" No. 25A Heald
GRINDER, SURF. 36" No. 16 Blanchard, 1940
GRINDER, CUTTER. 30" Ingersoll, 1942
GRINDER, CARBIDE, Nos. 48 and 49 Excello
GRINDER, RADIUS. No. 49 VanNorman, late
GRINDER, TOOL & CUTTER. No. 2 Cincinnati
HOB SHARPENER. Type HRS Barber Colman
KELLER. BL2416 Pratt & Whitney 3 Spdl., 1941
LATHES, ENGINE. 13", 15" & 17" LeBlond
MILLER, AUTO 2-20 Kent Owens, 1942
MILLER, AUTO 36" No. 33 Sundstrand
MILLER HAND. No. 2RV Kent-Owens, 1942
MILLERS. No. 10 & 3 VanNorman Duplex
MILLER, PLAIN. No. 2 Cincinnati HSDT, 1940
MILLER PLAIN. No. 3H K & T MSDT 1943
MILLER VERT. No. 2 Brown & Sharpe HSDT, 1943
MILLER. No. 36 VanNorman, ram type, 1942
ROUTERS, Type A-1R Onsrud Radial 84", late
SAW. 6" x 6" No. 6 Marvel Hack, late
SAW. 10" x 10" Racine Hydr., Hack, 1941
SHAPER. 6" P&W vert., also 12"
SHAPER, 16" Rockford hydr. univ. 1943
TAPPER No. 10 Warner & Swasey, 1948

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No. 000 Brown & Sharpe Plain Production, m.d.
No. 08 Cincinnati, rise and fall, 1944
M80 Taylor & Fenn Duplex, Spline, m.d.
No. MM-1-6 U.S. Multi-Miller, m.d.
No. 33H Sundstrand Trimplex Rigidmill, m.d.
No. 3A Sundstrand Plain Automatic Rigidmill, m.d.
24" Cincinnati Duplex Automatic, m.d.
48"x16' Newton Slab Miller, m.d.
54"x30"x16' Ingersoll Slab Miller, m.d.
Model 1402 Kearney & Trecker Simplex, m.d., production
Model 1404 Kearney & Trecker Simplex, m.d., production
No. 12 Brown & Sharpe Plain Horizontal, m.d.
No. 2-24 Cincinnati Plain Automatic, rise and fall m.d.
3-24" Cincinnati Duplex Hydromatic, m.d. in base
3-36" Cincinnati Duplex Hydromatic, m.d. in base
No. 4-36 Cincinnati Plain Hydromatic, m.d.
Model 33-1536 Sundstrand Simplex Fluid Screw Type Rigidmill, m.d.
No. 34-36 Cincinnati Semi-Special Plain Hydromatic, tracer control
28"x144" Cincinnati Plain Hydromatic, m.d., late
56-96 Cincinnati Plain Hydromatic, m.d. in base, 1944
56-72 Cincinnati Hydromatic Production, 1946
56-72 Cincinnati Duplex Hydromatic, 1941

ENGINE LATHES

12" Sebastian "Viking", m.d.
12½x42" Cincinnati Tray Top Model LE, new
13"x42" centers LeBlond "Regal", m.d.
13"x48" centers Pratt & Whitney, m.d.
14"x31¼" centers Lodge & Shipley, m.d.
14"x32¾" centers Springfield, m.d., taper
14"x33" centers Sidney, m.d.
14"x33¼ centers Lodge & Shipley, m.d.
14"x36" centers LeBlond Geared Head, s.p.d.
14"x36" centers Monarch, motorized, cone
14"x36" centers Pratt & Whitney, cone
14"x54" centers LeBlond Regal, m.d.
15"x18" Cincinnati Tray Top, m.d.
16"x28⅝" centers Hendey Yoke Head, m.d., taper
16x29 1/3" centers Lodge & Shipley Selective Head, m.d.
16"x29½" centers Monarch Geared Head, m.d.
16"x30" centers American High Duty, m.d.
16"x30" centers Monarch, m.d., taper
16"x30" centers Monarch, Model CW, m.d.
16"30" centers Hendey Geared Head, m.d.
16"x30" centers Reed Prentice, m.d.
16"x102" centers American High Duty, m.d.
16"x55⅛" centers Monarch, m.d.
18"x30" centers American, m.d., 8 speed
18"x44" Bradford Heavy Pattern, m.d.
18"x48" centers Lodge & Shipley, m.d.
18"x51" centers American Geared Head, m.d.
18"x49" centers Lodge & Shipley, m.d.
18"x51" centers Hendey Geared Head, m.d., taper
18"x54" centers American, m.d., Timken
18"x60" Cincinnati Tray Top, m.d.
18"x106" centers (110" centers Tailstock overhang) American, m.d.
19"x68" centers LeBlond Geared Head, m.d.
18"x126" centers Lodge & Shipley Selective Geared Head
20"x46¾" centers Lodge & Shipley, m.d.
20"x48" centers Boye & Emmes, m.d.
20"x55" centers Greaves-Klusman, m.d.
20"x70" centers American, m.d., taper
20"x72" centers Boye & Emmes, cone motorized
30"x77" centers Sidney Geared Head, m.d.
20"x96" centers Boye & Emmes, Model C, m.d., New
21"x42" centers LeBlond, m.d., taper
21"61⅛" centers LeBlond, m.d.
24"x51¼" centers Lodge & Shipley, m.d., taper
24"x18' 3¾" centers (if used with tailstock) 24' bed Lodge & Shipley, m.d.
25"x49" centers LeBlond Geared Head, m.d., taper
25"x50"x7'7" centers LeBlond Gap, m.d.
27"x96" centers American H.D., m.d., late
27"x48" centers LeBlond, m.d.
27"x104" centers Niles "Time Saver", m.d.
27"x120" centers LeBlond, m.d., 1944
27"x168" centers LeBlond, m.d.
27"x41' centers Niles, p.r.t., 1944
30"x76" centers Niles-Bement-Pond, m.d., taper
42"x31'—1⅛" centers American H.D., m.d.
54"x174" centers Houston, Stanwood, & Gamble, Heavy Type, m.d.
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No. 1B Milwaukee, m.d. in rear
No. 2 Cincinnati H.P., m.d.
No. 2K Kearney & Trecker, m.d.
No. 2B Brown & Sharpe, m.d.
No. 3B Brown & Sharpe, m.d.
No. 3B Milwaukee, m.d.
No. 38P Van Norman, m.d.
No. 4 Cincinnati Plain H.P., m.d.
No. 4B Brown & Sharpe, m.d.
No. 5 Cincinnati H.P., m.d., late
No. 2LP Van Norman, m.d.
No. 36 Van Norman Ram Type, m.d.

THREAD MILLING MACHINES

10x48" Hanson & Whitney Universal Semi-Automatic, m.d.
12x36" Lees-Bradner Universal Type, m.d.
12x54" Lees-Bradner Universal Type, m.d.
12x102" Lees-Bradner Universal Type, m.d.
No. 40 Lees-Bradner Automatic Universal, m.d., late

UNIVERSAL MILLING MACHINES

No. 2 Brown & Sharpe Light Type, flanged m.d., late
No. 3A Brown & Sharpe Standard Type, m.d., late
No. 2 Kempsmith Master-Mill, Model KMB
No. 2MH Cincinnati Universal, m.d.
No. 3K Kearney & Trecker, m.d.

VERTICAL MILLING MACHINES

No. 08 Cincinnati, m.d., latest
No. 1-14 Kent Owens, m.d.
No. 2H Kearney & Trecker, m.d.
No. 2K Kearney & Trecker, m.d.
No. 3VG Reed Prentice Vertical Miller & Die Sinking Machine, m.d.
No. 4 Cincinnati H.S., Dial Type, m.d.
No. 4K Kearney & Trecker, m.d.
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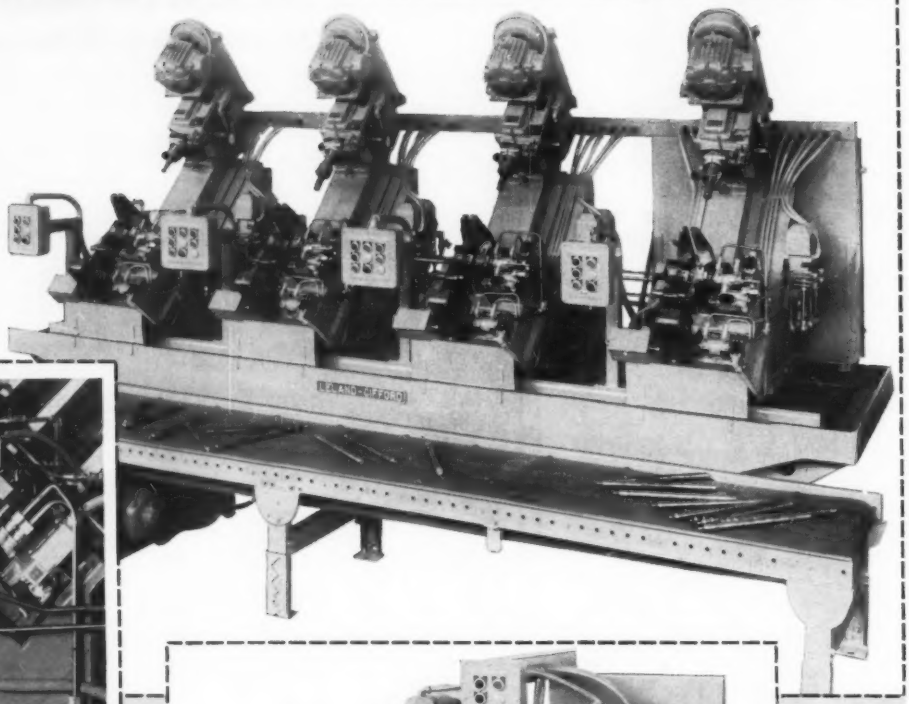

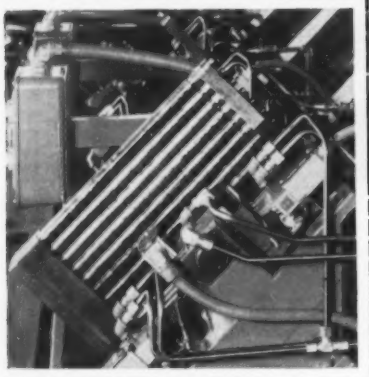

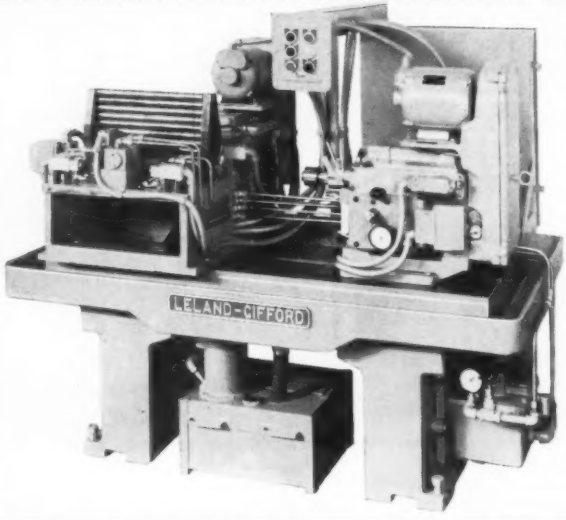

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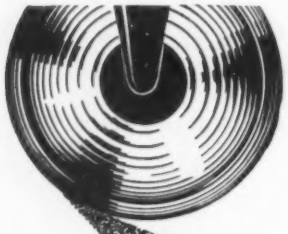

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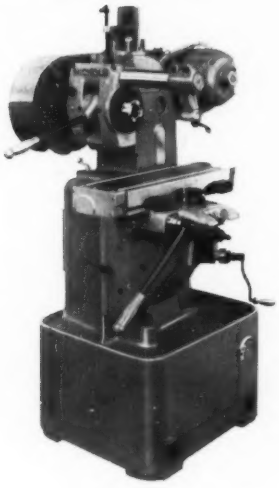

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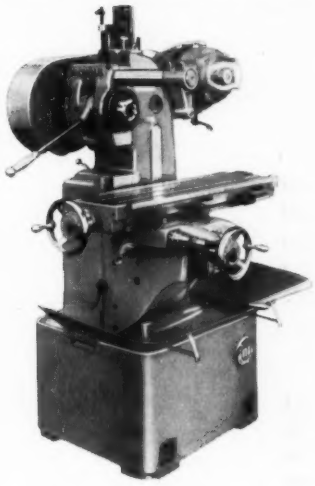
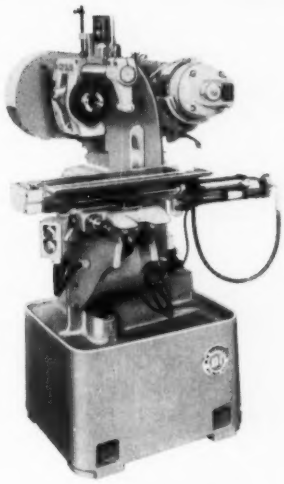
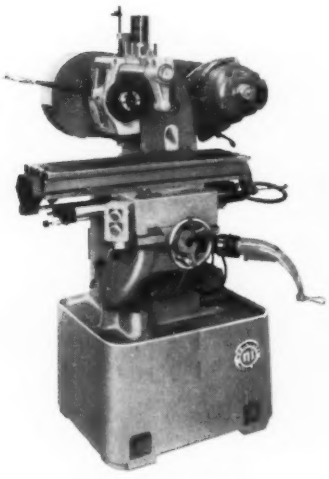


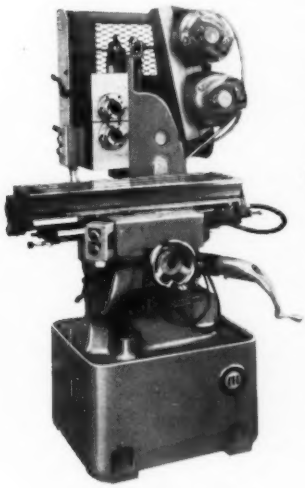
TOOL ROOM MODEL – Large 8½" x 30" table equipped with Micro Screw and Lever Feed. Extremely accurate and adaptable.



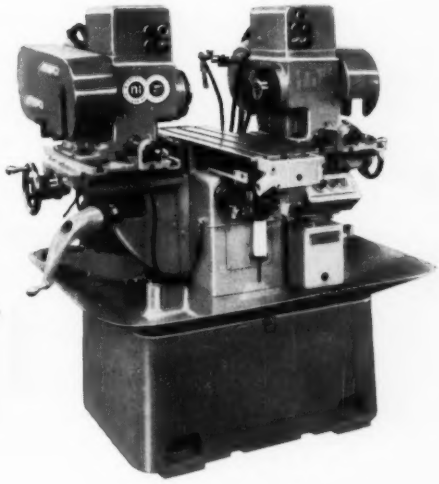
6SA SEMI-AUTOMATIC—Automatic pneumatic table feed converts Standard Model to a fast high production unit.



8SA SEMI-AUTOMATIC – Large 8½" x 30" Table on Heavy Duty Knee extends work and tooling range.



DOUBLE-DECKER—One of several duplex models for long run production. Hand feed or automatic table cycling.



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